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SURGERY IN PATIENTS OF ADVANCED AGE

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THE medical profession is well aware of the immediate usefulness of their many recent discoveries, but I doubt if many of them are conscious of the more remote effects of these discoveries on society and specifically of their influence in changing the various aspects of the practice of medicine.

Any change in the age composition of the population must influence business, politics, philosophy and the practice of medicine. We are in the midst of an amazing change in the age composition of the population of this country, which makes it worth while to have something more than a purely personal interest in the diseases of advanced life.

In 1850, life expectancy in this country was about 39 years for white males and 40 years for white females. In 1931, the average duration of life had increased to nearly 59 years for white males and to more than 62 years for white females. In New Zealand, in 1931, the average expectancy of life had reached the amazing figure of 65.04 years. This increase in total life expectancy is due, for the most part, to the great reduction in infant mortality, but there has been some reduction in the mortality rates of all ages of white males up to 55 years, and all ages of white females.

Associated with this decrease in mortality rate there has been a significant decrease in the birth rate, and the simultaneous operation of these two factors produces an inevitable shift in the age composition of the population towards the higher ages. In 1850, 2.6 per cent of the population were over 65 years of age. In 1931, 5.4 per cent of the population were over 65 years old. If the present trend continues for the same period as the present life expectancy period, the population will then contain 18.5 per cent, or more than 28 million men and women above the age of 65 years.[1] Or, stated another way: A white male citizen 35 years old in 1937, and subsequently realizing his life expectancy, will find himself in 1970 one of twenty-two and one-half million citizens of the United States who are as old or older than he. This is in contrast with the half million in 1850 or the three and one-quarter millions in 1900 (Table I).

An appreciation of this aging of the population impels an interest in the distribution of diseases in the advanced ages and particularly in the various methods of prevention and treatment of diseases peculiar to old age. The

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half million old men and women of 1850 could be told that they were too old to be operated upon, but in 1950 the twelve and one-half millions of corresponding ages will consider themselves too young to be so carelessly dealt with.

TABLE I

AGE COMPOSITION OF THE POPULATION[1]

Observed for 1850, 1900, and 1930; and calculated for 1950 and 1970

Year	Total Population (Millions)	Under 20 Years (Millions)	Ages 20–49 Years (Millions)	Ages 50–64 Years (Millions)	Ages 65 and Over (Millions)
1850.....	23.2	12.1	8.9	1.4	0.6
1900.....	76.0	33.7	32.0	7.1	3.1
1930.....	122.8	47.6	54.0	14.4	6.6
1950.....	138.3	40.1	63.2	22.4	12.5
1970.....	151.4	40.6	59.8	28.6	22.4

This paper is a brief summary of the immediate and remote results of operative treatment of patients more than 70 years of age in the Vanderbilt University Hospital during the period from 1926 to 1935, inclusive. During this period there have been 41,000 admissions; 15,181 operations have been performed in the general operating rooms; and approximately 9,000 operations on the eye, nose and throat have been carried out in a special operating room used by the ophthalmologic and otolaryngologic divisions. Minor operations performed in the ward dressing rooms and the outpatient service have not been included. Two hundred ninety-three operations have been performed on 287 patients over 70 years of age. All of these patients except two have been traced until the date of death or the age attained in 1936. One hundred thirty-six of these patients were living in 1936.

The tables show the nature and incidence of the disease treated by operation. A brief summary of the records of all the patients dying in the hospital is given. After obtaining definite information concerning the subsequent course of the 251 patients discharged from the hospital, some method of evaluation of the duration of life was sought. In dealing with a group of patients over 70 years of age, it must be remembered that life expectancy is short and that there are relatively large changes in the life expectancy of successive ages. On the other hand, the gross error in estimating probable duration of life in an individual instance or in a small group is certainly less if this individual or group is in the higher rather than in the lower age class. In dealing with such small groups, it was not considered worthwhile to use separate tables for white and colored, male and female. The American Experience Life Table was chosen as a standard for estimating life expectancies, because this table is the one most widely used in spite of its rather vague foundations (Table II).

The seventieth birthday was chosen as the beginning of old age, not only because this age has since the beginning of history marked the span of life, but also because it did not seem appropriate to include in old age, individuals who had only just reached the average duration of life. It seemed, also,

TABLE II

AMERICAN EXPERIENCE LIFE TABLE

Age	Complete Expectation of Life	Age	Complete Expectation of Life
70	8.48	80	4.39
71	8.00	81	4.05
72	7.55	82	3.71
73	7.11	83	3.39
74	6.68	84	3.08
75	6.27	85	2.77
76	5.88	86	2.47
77	5.49	87	2.18
78	5.11	88	1.91
79	4.74	89	1.66

that selecting only patients over 70 would be more significant in showing a trend than if those between 65 and 70 were included. Bailey[2] summarized the previous literature on surgery in the higher age classes in his report of the results of operations upon 185 cases over 60 years of age. Only 51 of these cases, however, were over 70 years of age. More recently, Morton[3] has reported the results obtained in operations on 29 cases over 70 years old. Both of these authors believe that there is little evidence for the truth of the popular belief that advanced age is a strong contraindication for the employment of operative treatment. Morton, I believe, quite correctly attributes the credit to the urologists for demonstrating that operative treatment could be successfully carried out in individuals of advanced age even in the presence of infection and advanced renal insufficiency from urinary obstruction by enlargement of the prostate.

TABLE III

OPHTHALMOLOGIC OPERATIONS

Type of Operation	(70–89)		(70–74)		(75–79)		(80–84)		(85–89)	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Operation for cataract	47	1	22	0	14	1	11	0	0	0
Iridectomy	4	0	3	0	0	0	1	0	0	0
Operation on eyelid	5	0	3	0	2	0	0	0	0	0
Enucleation of eye	6	0	3	0	3	0	0	0	0	0
Transplantation, pterygium	2	0	2	0	0	0	0	0	0	0
Extraction foreign body	1	0	1	0	0	0	0	0	0	0
Totals	65	1	34	0	19	1	12	0	0	0

Deaths—1

White, male, 79. Cataract extracted. Developed fever seventh postoperative day. Died within 24 hours. Autopsy.—Coronary occlusion, with infarction.

Length of Life

Life expectancy, entire group ..... 414.6 years
Life expectancy, group discharged from hospital 409.9
Life realization, entire group 239.5
Life expectancy, survivors in 1936 ..... 180.4 } 419.9

TABLE IV

OTOLARYNGOLOGIC OPERATIONS

Type of Operation	(70–89) Cases	(70–89) Deaths	(70–74) Cases	(70–74) Deaths	(75–79) Cases	(75–79) Deaths	(80–84) Cases	(80–84) Deaths	(85–89) Cases	(85–89) Deaths
Mastoidectomy	2	0	1	0	0	0	1	0	0	0
Excision tumor larynx	2	0	2	0	0	0	0	0	0	0
Drainage frontal sinus	1	0	1	0	0	0	0	0	0	0
Excision nasal polyp	1	0	1	0	0	0	0	0	0	0
Totals	6	0	5	0	0	0	1	0	0	0

Deaths—0

Length of Life

Life expectancy, entire group ..... 44.2 years
Life realization, entire group 37.4
Life expectancy, survivors in 1936 ..... 22.8 ..... 60.2

TABLE V

GENITO-URINARY OPERATIONS

Type of Operation	(70–89) Cases	(70–89) Deaths	(70–74) Cases	(70–74) Deaths	(75–79) Cases	(75–79) Deaths	(80–84) Cases	(80–84) Deaths	(85–89) Cases	(85–89) Deaths
Two stage prostatectomy	29	3	14	1	14	1	1	1	0	0
Perineal prostatectomy	2	0	1	0	1	0	0	0	0	0
One stage prostatectomy	1	0	1	0	0	0	0	0	0	0
Resection of prostate	11	0	6	0	2	0	3	0	0	0
Suprapubic cystostomy for benign hypertrophy	8	6	2	2	3	2	0	0	3	2
Suprapubic cystostomy for cancer prostate	4	3	1	1	3	2	0	0	0	0
Suprapubic cystostomy for stone in bladder	4	0	2	0	0	0	0	0	2	0
Suprapubic cystostomy for cancer bladder	1	0	1	0	0	0	0	0	0	0
Suprapubic cystostomy for ruptured bladder	1	1	0	0	0	0	1	1	0	0
Suprapubic cystostomy for carcinoma urethra	1	1	1	1	0	0	0	0	0	0
Excision urethral caruncle	1	0	0	0	1	0	0	0	0	0
Nephrectomy (carcinoma)	1	1	1	1	0	0	0	0	0	0
Excision hydrocele	4	0	4	0	0	0	0	0	0	0
Totals	68	15	34	6	24	5	5	2	5	2

Deaths—15

(1) Male, white, 70. Benign hypertrophy prostate. Two stage prostatectomy. Acute parotitis, sixth postoperative day. Died ninth postoperative day. No autopsy.

(2) Male, white, 79. Benign hypertrophy prostate. Two stage prostatectomy. Progressive fall in blood pressure. Died from pneumonia fourteenth postoperative day. Autopsy.—Bronchopneumonia.

(3) Male, white, 82. Benign hypertrophy prostate. Two stage prostatectomy. Died suddenly five weeks after operation. Autopsy.—Coronary occlusion.

(4) Male, white, 74. Benign hypertrophy prostate. Suprapubic cystostomy. Abrupt rise in temperature third postoperative day. Died sixth postoperative day. No autopsy.

(5) Male, colored, 74. Benign hypertrophy prostate. Severe urinary infection. Irrational. Suprapubic cystostomy. Died sixth postoperative day. No autopsy.

(6) Male, colored, 76. Benign hypertrophy prostate. Urethral bleeding. Suprapubic cystostomy. Death in 24 hours. Autopsy.—Fibroma prostate; pyelonephritis; bronchopneumonia; pleural effusion.

(7) Male, white, 77. Benign hypertrophy prostate. Suprapubic cystostomy. Progressive decline until death on thirty-eighth postoperative day. Autopsy.—Coronary occlusion.

(8) Male, white, 86. Benign hypertrophy prostate. Acute retention urine. Suprapubic cystostomy. Died from penumonia, third postoperative day. No autopsy.

(9) Male, colored, 88. Benign hypertrophy prostate. Acute retention urine 18 hours. Suprapubic cystostomy. Died within 36 hours. Autopsy.—Thrombosis pulmonary artery; general peritonitis.

(10) Male, white, 70. Carcinoma prostate. Suprapubic cystostomy. Progressive decline until death on fifteenth postoperative day. Autopsy.—Carcinoma prostate; multiple abscesses kidney.

(11) Male, white, 76. Carcinoma prostate. Suprapubic cystostomy. Fever continued. Died fifth postoperative day. Autopsy.—Carcinoma prostate with metastases to bladder, seminal vesicles, retroperitoneal lymph nodes. Bronchopneumonia.

(12) Male, white, 78. Carcinoma prostate. Suprapubic cystostomy. Progressive weakness. Sharp rise temperature ninth postoperative day. Died seventeenth postoperative day. Autopsy.—Carcinoma prostate; abscess of lung; empyema.

(13) Male, white, 80. Ruptured bladder, traumatic. Suprapubic cystostomy. Extensive extravasation of urine into suprapubic spaces. Died twenty-ninth postoperative day. No autopsy.

(14) Male, white, 72. Carcinoma kidney. Nephrectomy. Died 24 hours following operation. Autopsy.—Squamous cell carcinoma left kidney with metastases to liver, pancreas, diaphragm, lungs.

(15) Female, white, 70. Radical removal urethral tumor 12 months previously. Local recurrence excised. Died seventh postoperative day. Autopsy.—Adenocarcinoma urethra; pyelonephritis; chronic pleuritis.

Length of Life

Life expectancy, entire group ..... 40.8 years
Life expectancy, group discharged from hospital 32.2.3
Life realization, entire group ..... 14.2.5 } 28.0.6
Life expectancy, survivors in 1936 ..... 13.8.1 }

TABLE VI

ABDOMINAL OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Exploratory laparotomy, inoperable cancer	6	3	5	3	1	0	0	0	0	0
Gastrostomy, cancer esophagus	4	1	3	1	1	0	0	0	0	0
Gastro-enterostomy, cancer	4	2	2	0	2	2	0	0	0	0
Gastro-enterostomy, ulcer	1	0	1	0	0	0	0	0	0	0

TABLE VI—*Continued*

Resection of stomach	1	0	1	0	0	0	0	0	0	0
Closure of perforated duodenal ulcer	1	0	1	0	0	0	0	0	0	0
Laparotomy for perforated gallbladder	1	1	0	0	1	1	0	0	0	0
Cholecystectomy	7	1	6	1	1	0	0	0	0	0
Choledocostomy	1	0	1	0	0	0	0	0	0	0
Cholecystogastrostomy	1	0	1	0	0	0	0	0	0	0
Appendicectomy, drainage	1	0	1	0	0	0	0	0	0	0
Operation for acute intestinal obstruction	5	3	3	1	2	2	0	0	0	0
Totals	33	11	25	6	8	5	0	0	0	0

Deaths—11

(1) Male, white, 70. Laparotomy. Inoperable tumor, hilus of liver. Progressive weakness until death on twenty-fourth postoperative day. No autopsy.

(2) Male, white, 73. Laparotomy. Carcinomatosis peritoneum and liver. Progressive weakness until death on twelfth postoperative day. No autopsy.

(3) Female, white, 73. Laparotomy. Carcinomatosis peritoneum. Progressive weakness until death on seventh postoperative day. No autopsy.

(4) Female, colored, 72. Carcinoma esophagus. Gastrostomy. Progressive weakness until death on seventh postoperative day. Autopsy.—Lung metastases; bronchopneumonia.

(5) Female, white, 77. Large mass of cancer obstructing the pylorus. Posterior gastroenterostomy. Convalescence uneventful until twelfth postoperative day. Sudden onset of chill, fever and intense jaundice. Death fourteenth postoperative day. No autopsy.

(6) Male, white, 77. Extensive carcinoma pyloric end stomach. Posterior gastroenterostomy. Died twenty-four hours after operation. No autopsy.

(7) Female, white, 75. Laparotomy. Gangrene gallbladder. General peritonitis. Drainage of peritoneum. Died two hours after operation. Autopsy.—General peritonitis.

(8) Female, white, 71. Fistula between gallbladder and duodenum. Cholecystectomy. Closure duodenal fistula. Found dead in bed ninth postoperative day. Autopsy.—Thrombosis coronary artery.

(9) Male, white, 74. Laparotomy. Volvulus of sigmoid, five days' duration. Perforation of bowel. General peritonitis. Died day of operation.

(10) Female, white, 76. Symptoms intestinal obstruction two days. Large abdominal mass. Colostomy. Died fourth postoperative day. Autopsy.—Dissecting aneurysm abdominal aorta.

(11) Male, white, 79. Acute abdominal pain, nausea and vomiting 2½ days. Coronary disease suspected. Observed 12 hours. Laparotomy. Partial obstruction ileum by band. Convalescence uneventful until twelfth postoperative day when patient 12 hours after onset had characteristic attack coronary occlusion. Autopsy.—Coronary occlusion.

Length of Life

Life expectancy, entire group	33.8 years	
Life expectancy group discharged from hospital	61.0	
Life realization, entire group	36.4	98.2
Life expectancy, survivors in 1936	61.8	

TABLE VII

HERNIA OPERATIONS

Type of Operation	(70-89)		(70-74)		(75-79)		(80-84)		(85-89)	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Radical cure ventral hernia	2	0	1	0	1	0	0	0	0	0
Strangulated femoral hernia	2	0	0	0	0	0	1	0	1	0
Strangulated inguinal hernia	6	1	2	0	1	0	3	1	0	0
Inguinal hernia, reducible	10	0	8	0	1	0	1	0	0	0
Totals	20	1	11	0	3	0	5	1	1	0

Deaths—1

Colored, male, 80. Irreducible hernia, one week. Cold, pulseless on admission. Operative reduction of hernia. Death nine hours after operation. Autopsy.—Mural thrombi right heart; pulmonary infarction; peritonitis; senile changes.

Length of Life

Life expectancy, entire group		127.0 years
Life expectancy, group discharged from hospital		122.7
Life realization, entire group	61.9	131.4
Life expectancy, survivors in 1936	69.5	

TABLE VIII

MAMMARY GLAND OPERATIONS

Type of Operation	(70-89)		(70-74)		(75-79)		(80-84)		(85-89)	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Radical mastectomy	3	0	3	0	0	0	0	0	0	0
Simple mastectomy, cancer	5	0	4	0	1	0	0	0	0	0
Excision recurrent cancer	1	0	1	0	0	0	0	0	0	0
Simple mastectomy, chronic mastitis	1	0	0	0	1	0	0	0	0	0
Totals	10	0	8	0	2	0	0	0	0	0

Deaths—0

Length of Life

Life expectancy, entire group		71.5 years
Life realization, entire group	31.8	71.3
Life expectancy, survivors, 1936	39.5	

TABLE IX

RECTAL OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Hemorrhoids	3	0	1	0	1	0	1	0	0	0
Fistulae	1	0	1	0	0	0	0	0	0	0
Perirectal abscess	1	1	0	0	0	0	1	1	0	0
Benign ulcer rectum	1	0	1	0	0	0	0	0	0	0
Totals	6	1	3	0	1	0	2	1	0	0

Deaths—1

White, female, 80. Large perirectal abscess, unknown duration. Incision and drainage. Temperature continued elevated; pulse rate increased. Death on fourth postoperative day. No autopsy.

Length of Life

Life expectancy, entire group ..... 38.2 years
Life expectancy, group discharged from hospital 33.9
Life realization, entire group 40
Life expectancy, survivors in 1936 ..... 8 .... 48.0

TABLE X

NEUROLOGIC OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Operation on gasserian ganglion	8	0	3	0	4	0	1	0	0	0
Craniotomy for fractured skull	2	0	2	0	0	0	0	0	0	0
Laminectomy, chordotomy	1	0	0	0	1	0	0	0	0	0
Totals	11	0	5	0	5	0	1	0	0	0

Deaths—0

Length of Life

Life expectancy, entire group ..... 71.0 years
Life realization, entire group 36.2
Life expectancy, survivors in 1936 ..... 40.4 .. 76.6

TABLE XI

OPERATIONS FOR CIRCULATORY DISEASE

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Amputation for gangrene	6	1	4	0	2	1	0	0	0	0
Operation for varicose veins	4	1	3	0	1	1	0	0	0	0
Ligation vein for gangrene	1	0	1	0	0	0	0	0	0	0
Totals	11	2	8	0	3	2	0	0	0	0

Deaths—2

(1) White, male, 77. Extensive gangrene leg one week's duration. Guillotine thigh amputation. Died 24 hours after operation. Autopsy.—Marked arteriosclerosis; bronchopneumonia.

(2) White, male, 75. Chronic ulcer leg excised, using local anesthetic. Chill, high fever, seventh postoperative day. Died within 24 hours. Autopsy.—No satisfactory cause of death found.

Length of Life

Life expectancy, entire group		77.8 years
Life expectancy, group discharged from hospital		66.0
Life realization, entire group	27.0	33.6
Life expectancy, survivors in 1936	6.6	

TABLE XII

OPERATIONS FOR SUPERFICIAL NEOPLASMS

Type of Operation	(70-89)		(70-74)		(75-79)		(80-84)		(85-89)	
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Excision epithelioma face	10	1	5	1	4	0	1	0	0	0
Excision melanoma face	2	0	2	0	0	0	0	0	0	0
Excision angio-endothelioma face	1	0	0	0	0	0	1	0	0	0
Excision sarcoma face	1	0	1	0	0	0	0	0	0	0
Cavernous hemangioma face, ligation carotid artery	1	0	0	0	1	0	0	0	0	0
Excision tumor lip	4	0	1	0	2	0	1	0	0	0
Excision epithelioma neck	7	0	4	0	2	0	0	0	1	0
Excision carcinoma gum	3	0	2	0	1	0	0	0	0	0
Excision squamous cell carcinoma hand	7	0	3	0	3	0	0	0	1	0
Excision squamous cell carcinoma vulva	1	0	1	0	0	0	0	0	0	0
Excision mixed tumor parotid	1	0	0	0	1	0	0	0	0	0
Excision tumor chest wall	1	0	0	0	1	0	0	0	0	0
Totals	39	1	19	1	15	0	3	0	2	0

Deaths—1

White, male, 70. Large epithelioma of face destroyed with cautery. Died nine weeks later. Autopsy.—Fibrinopurulent meningitis.

Length of Life

Life expectancy, entire group		246 years
Life expectancy, group discharged from hospital		237.5
Life realization, entire group	99.0	193.5
Life expectancy, survivors in 1936	94.5	

TABLE XIII

THYROID OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Partial thyroidectomy (hyperthyroidism)	2	1	2	1	0	0	0	0	0	0
Partial thyroidectomy (cancer)	1	0	1	0	0	0	0	0	0	0
Totals	3	1	3	1	0	0	0	0	0	0

Deaths—1

White, female, 73. Diffuse toxic goiter. Chronic heart disease. Partial thyroidectomy. Died second postoperative day. Autopsy.—No satisfactory explanation of death.

Length of Life

Life expectancy, entire group		23.5 years
Life expectancy, group discharged from hospital		16.5
Life realization, entire group	0.16	0.16
Life expectancy, survivors in 1936	0.00	

TABLE XIV

BONE AND JOINT OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Amputation (tuberculosis tibia)	1	0	0	0	1	0	0	0	0	0
Osteotomy for osteomyelitis (os calcis)	1	0	1	0	0	0	0	0	0	0
Closed reduction (fractures)	8	0	6	0	2	0	0	0	0	0
Open reduction dislocation (carpal)	1	0	1	0	0	0	0	0	0	0
Totals	11	0	8	0	3	0	0	0	0	0

Deaths—0

Length of Life

Life expectancy, entire group		79.5 years
Life realization, entire group	30.0	86.6
Life expectancy, survivors in 1936	56.6	

TABLE XV

INCISION AND DRAINAGE OF INFECTIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Incision-drainage infection neck	2	1	2	1	0	0	0	0	0	0
Incision-drainage infection buttock	1	0	1	0	0	0	0	0	0	0
Incision-drainage infection, carbuncle	1	0	0	0	1	0	0	0	0	0
Incision-drainage abscess (flank)	1	0	1	0	0	0	0	0	0	0
Totals	5	1	4	1	1	0	0	0	0	0

Deaths—1

White, female, 74. Extensive infection neck five days' duration. Nitrous oxide anesthesia. Abscess drained. Died suddenly few hours after operation. No autopsy. Death presumably cardiac.

Length of Life

Life expectancy, entire group		26.9 years
Life expectancy, group discharged from hospital		20.2
Life realization, entire group	5.3	15.1
Life expectancy, survivors in 1936	9.8	

TABLE XVI

GYNECOLOGIC OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Oophorectomy (tumor)	1	0	1	0	0	0	0	0	0	0
Dilatation and curettage	1	0	1	0	0	0	0	0	0	0
Anterior suspension uterus	1	1	1	1	0	0	0	0	0	0
Totals	3	1	3	1	0	0	0	0	0	0

Deaths—1

White, female, 71. Complete prolapse uterus. Anterior suspension. Irregular daily elevations of temperature until ninth postoperative day, when patient suddenly developed extreme dyspnea. Palpable pulse disappeared. Died 16 days following operation. Autopsy. —Extensive bilateral acute bronchopneumonia with pulmonary infarctions.

Length of Life

Life expectancy, entire group		22.5 years
Life expectancy, group discharged from hospital		14.5
Life realization, entire group	7.0	13.2
Life expectancy, survivors in 1936	6.2	

TABLE XVII

CHEST OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Drainage lung abscess	1	1	1	1	0	0	0	0	0	0

Deaths—1

Male, white, 71. On admission, moribund. Lung abscess; secondary empyema. Empyema drained. Died less than 24 hours postoperative. No autopsy.

Length of Life

Life expectancy, entire group		8 years
Life expectancy, group discharged from hospital		0
Life realization, entire group	0	0
Life expectancy, survivors in 1936	0	

TABLE XVIII

PLASTIC OPERATIONS

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Plastic operation for burn	1	0	1	0	0	0	0	0	0	0

Deaths—0

Life expectancy, entire group		8 years
Life realization, entire group	1.1	1.1
Life expectancy, survivors in 1936	0.0	

TABLE XIX

OPERATIONS IN ADVANCED AGES

Type of Operation	(70-89) Cases	(70-89) Deaths	(70-74) Cases	(70-74) Deaths	(75-79) Cases	(75-79) Deaths	(80-84) Cases	(80-84) Deaths	(85-89) Cases	(85-89) Deaths
Ophthalmologic	65	1	34	0	19	1	12	0	0	0
Otolaryngologic	6	0	5	0	0	0	1	0	0	0
Genito-urinary	68	15	34	6	24	5	5	2	5	2
Gynecologic	3	1	3	1	0	0	0	0	0	0
Abdominal	33	11	25	6	8	5	0	0	0	0
Hernia	20	1	11	0	3	0	5	1	1	0
Rectal	6	1	3	0	1	0	2	1	0	0
Mammary gland	10	0	8	0	2	0	0	0	0	0
Thyroid	3	1	3	1	0	0	0	0	0	0
Neurologic	11	0	5	0	5	0	1	0	0	0

TABLE XIX—*Continued*

Superficial neoplasms	39	1	19	1	15	0	3	0	2	0
Bone and joint	11	0	8	0	3	0	0	0	0	0
Infections	5	1	4	1	1	0	0	0	0	0
Circulatory disease	11	2	8	0	3	2	0	0	0	0
Chest	1	1	1	1	0	0	0	0	0	0
Plastic	1	0	1	0	0	0	0	0	0	0
Totals	293	36	172	17	84	13	29	4	8	2
	12.3%		9.9%		15.4%		13.7%		25%	

Length of Life

Life expectancy, entire group	1900.5 years	
Life expectancy, group discharged from hospital	1404.5	
Life realization, entire group	795.2	1529.4
Life expectancy, survivors in 1936	734.2	

From the results obtained in this group of 293 operations on patients more than 70 years of age, it appears that surgical diseases in the higher age groups are associated with a relatively high mortality, but that deaths which could be reasonably attributed to operative treatment are remarkably infrequent. In other words, increasing the proportion of patients in the higher age groups in surgical wards would increase the hospital mortality rate, but should not increase the hazard of operative treatment. For example, in the genito-urinary operations, in which group 15, or more than one-third of all deaths occurred, only three patients died who had been considered in sufficiently good condition to have any more than the preliminary suprapubic cystostomy, or nine deaths occurred in patients in whom urinary obstruction made suprapubic cystostomy obligatory and death ensued before operative treatment of the primary disease could be undertaken. Or, to approach this question from another viewpoint, if only those groups of patients are chosen in which some operative procedure was undertaken solely for the purpose of relief of some distressing symptom, caused by a condition which presumably would not necessarily decrease life expectancy; i.e., reducible hernia, cataract, tic douloureux, gallbladder disease (without gangrene or perforation), and benign abnormalities of the rectum, there were 90 cases operated upon with one death from coronary occlusion on the seventh postoperative day. Assuming an average of one month's residence in the hospital, this death rate is approximately the same as occurs in the general population at the age of 75. Life realization of these groups was apparently in excess of that calculated from the American Experience Life Table. These results also cast a considerable amount of doubt on the generally accepted opinion that simple confinement to bed during advanced life is dangerous.

The presence of a malignant tumor was responsible for 72, or 24.5 per cent, of the 293 operations. In 31 of these cases the malignant tumor was about the face or neck, and the frequency with which epithelioma of the dorsum of the hand occurred, seven times, is interesting. In general, the

results obtained in cancer, except intra-abdominal cancer, were remarkably good. In the group of superficial epitheliomata, life expectancy was not alarmingly diminished, and the only death which occurred in the hospital was in an instance of epithelioma of the forehead which had been neglected until extensive invasion of the bone was present. Fifteen of 33 abdominal operations were performed for cancer and six of these patients died in the hospital. Those discharged all died within a year except two who had gastro-enterostomies for carcinoma of the pylorus. One of these lived 16 months, and one is alive four years after operation. The latter is probably an instance of mistaken diagnosis.

The group which is most discouraging is that requiring abdominal section. One-third of these patients died in the hospital, and the survivors have realized only a small fraction of their life expectancy. In those patients who died in the hospital, it was obvious that no death could be attributed to an operation. Six patients had inoperable cancer, three were suffering from intestinal obstruction, and one had general peritonitis from rupture of a gangrenous gallbladder. The remaining death which occurred has a particular bearing on the subject of this paper. This patient was first seen in 1925 with gall-bladder disease. Because of age, hypertension and complete cessation of symptoms during her stay in the hospital, operation was not advised. The attacks recurred with increasing frequency and severity until 1927, at which time she was admitted in such a condition that operation was unavoidable. The gallbladder was found ruptured into the duodenum. After removal of the gallbladder, convalescence was quite satisfactory for nine days, when the patient died suddenly of coronary occlusion. It seems unavoidable to escape the conclusion that operation should have been undertaken in 1925.

It is also of interest to compare the incidence of some of the surgical

TABLE XX

RELATIVE INCIDENCE OF OPERATIVE PROCEDURES FOR SIMILAR CONDITIONS IN PATIENTS UNDER SEVENTY AND OVER SEVENTY YEARS OF AGE

Type of Operation	Total Number of Operations	Operations upon Patients over 70 years Old	Percentage
Appendicectomy	975	1	0.1
Thoracostomy	199	1	0.5
Thyroidectomy, partial	369	3	0.8
Cholecystectomy	337	7	2.0
Stomach resection	43	1	2.3
Excision mammary gland, radical	101	3	2.9
Hernia	542	20	3.6
Excision posterior root (gasserian ganglion)	49	8	16.1
Cataract	195	47	24.1
Prostatic	152	55	36.1
Totals	2,962	146	4.9

diseases occurring after the age of 70 with the incidence of these same diseases in younger patients during the same period. Table XX indicates the relative incidence for a few of the more frequent operative procedures.

There is without doubt a technic for handling sick old people which improves the chance of recovery. Just as there is a personal fitness for dealing with children, there is also an effective attitude to adopt toward the aged. They need to be surrounded with an atmosphere of optimism, and it is perhaps even more important to guard a patient of advanced age against exposure to an acute respiratory infection than to prevent the exposure of a child to a contagious disease. The importance of careful study and preoperative treatment for existing disease of the heart and kidneys in dealing with patients of advanced age is already generally appreciated.

It is at least amusing to speculate about the effects of the shift in the age composition and the stabilization of the population in number and age composition, on the present set up of specialization in the practice of medicine. In general, the obstetricians and the pediatricians can anticipate a diminution in numbers of births and children. The internists can certainly look forward to an increase in the incidence of the degenerative diseases. The surgeons may reasonably expect an increase in their responsibilities because the incidence of surgical diseases is certainly greater in individuals over 50 than under 20, but this increase in surgical disease will be unequally distributed among the various surgical specialties. The urologists will be a great deal busier with their much larger group of old men, but the gynecologists will probably not be seriously overworked with their even larger group of old women, because gynecologic conditions seem to occur relatively infrequently in the advanced ages. The ophthalmologists may look forward to performing more operations for cataract, but the otolaryngologists will do relatively few operations on the ear, nose and throat to compensate for the diminution in tonsillectomies and adenoidectomies. The orthopedic surgeons, I believe, are already aware of the great decrease in the incidence of tuberculosis of the hip and spine, and I note that orthopedic literature already shows evidence of an intensification of interest in arthritis of the spine. The neurologic surgeon can anticipate a less discouraging field after the addition of the increased number of operations for tic douloureux, and, finally, the plastic surgeon will have more operations for epitheliomata of the face and less operations for harelip and cleft palate.

I leave for your own reflection the results of the aging of that part of the population who are engaged in the teaching of medicine.

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SUBPHRENIC ABSCESS WITH BRONCHIAL FISTULA *

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RUPTURE of a subphrenic abscess into a bronchus is a relatively rare occurrence. In 1902, Cauderay[3] collected 20 proven cases of this complication and analyzed them in detail. Since the publication of his thesis, no detailed study has appeared in the literature. In 1909, Piquand,[9] in a collected series of 890 cases of subphrenic abscess, found 112 complicated by a bronchial fistula. Many of his cases, however, were not proven by operation or autopsy. Since 1909, only 13 proven cases have been reported. To these we are adding six cases which were admitted to the University of Michigan Hospital in the ten year period from January 1, 1926, to December 31, 1935. During this same period, a total of 48 cases of subphrenic abscess were operated upon or autopsied in this hospital.

Incidence.—The incidence of all pulmonary complications of subphrenic abscess was found by Ochsner and Graves[7] to rise with delayed diagnosis and treatment. The incidence of rupture of subphrenic abscess into a bronchus in our collected series of cases was 11.8 per cent. In our own series it was 12.5 per cent. The frequency of this complication in various series depends to a large extent upon the length of the period between the formation of the abscess and the time that the patient is first seen in the reporting clinic. Many cases of subphrenic abscess are admitted to the University of Michigan Hospital late in the course of their disease. Half of our cases with bronchial fistula were admitted after the rupture into the bronchus had occurred.

In reviewing a series of 60 perinephric abscesses admitted to the same hospital during a corresponding period of time, Nesbit and Keene[6] found six cases with bronchial fistula. They attributed the high incidence of this complication (10 per cent) to the delay in diagnosis and consequent delay in treatment.

Pathology.—The course the pus follows after perforation of the diaphragm depends on whether or not a free pleural space exists. If the basal portions of the pleurae are not adherent, perforation will be followed by an extensive empyema, which may rupture later into a bronchus. If, however, adhesions are present, the abscess will rupture directly into the lung or a small, localized empyema may be formed, which, in turn, will rupture into the lung. We were able to demonstrate this in two of our cases, once at autopsy (Case 5) and once at operation (Case 6). These empyemata were so small that they could not be diagnosed either clinically or roentgenologically.

A basilar pneumonitis frequently precedes the rupture of the pus into a

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TABLE I

RÉSUMÉ OF THE SIX CASES REPORTED

Name	Case No.	Sex	Age	Source of Infection	Nature of Abdominal Operation	Side	Time from Onset of Abdominal Symptoms to Rupture into Bronchus	Proof of Subphrenic Abscess	Empyema	Result	Remarks
H. M.	1	M	39	Acute appendicitis	Appendicectomy	R	9 da.	Operation	0	Recovered	Inadequate drainage of abscess —prolonged course
D. M.	2	M	28	Acute appendicitis	Appendicectomy	R	18 mos.	Operation	0	Recovered	Treated conservatively for two years—then drained
F. M.	3	M	29	Unknown	None	L	18 da.	Operation	0	Died	Sudden death on day of operation
T. M.	4	M	30	Ruptured appendix	None	R	13 da.	Operation	?	Recovered	
J. B.	5	M	48	Acute appendicitis	Appendicectomy	R	6 mos.	Autopsy	Small	Died	Localized empyema above perforation of diaphragm
J. G.	6	M	43	Unknown intra-abdominal	None	R	14 da.	Operation	Small	Died	Inadequate drainage of abscess —prolonged course—lived eight years

bronchus and becomes intensified immediately following the formation of the fistulous tract. The shadow cast by this pneumonitis is always the most conspicuous roentgenologic finding in these cases but is, of course, not diagnostic of the fistula.

In those cases in which the fistula has been present for a long period of time, patches of chronic pneumonitis and atelectasis may be present throughout the affected lung, due to repeated aspiration of pus into various branches of the bronchial tree.

Diagnosis.—The cardinal symptom of the rupture of a subphrenic abscess into a bronchus is a sudden coughing attack with the expectoration of a large quantity of pus. This pus usually has an extremely foul odor, which is characteristic of the causative organism, frequently the colon bacillus. The patient may have noticed an appreciable amount of sputum for a varying length of time before such an incident, but this is usually mucopurulent in character and can be accounted for by the pneumonitis existing prior to the rupture of the abscess into the bronchus. The quantity of the sputum following rupture is greatly increased over that produced by the pneumonitis alone and is much more purulent in character.

Rupture of an empyema, not occurring as a complication of subphrenic abscess, into a bronchus may, of course, produce a similar sudden expectoration of pus. The history of previous abdominal disease in the case of subphrenic abscess is often of aid in making a differential diagnosis although, occasionally, the abdominal symptoms may be obscure. Empyema as a complication of subphrenic abscess due to lymphatic extension of the infection rather than to perforation of the diaphragm is a possibility mentioned by Beye.[2] The rupture of such an empyema into a bronchus would produce a confusing clinical picture.

The length of time between the evident onset of the symptoms produced by the original abdominal focus of infection and the rupture of the abscess into the bronchus is inconstant. In our series of cases this period varied from nine days to 18 months, averaging about 18 weeks. In Cauderay's series, it varied from ten days to 23 months.

Roentgenograms may be of value in establishing the diagnosis of a subphrenic abscess with bronchial fistula. In some instances, the fistula will allow air to enter the abscess and thus produce an air bubble and fluid level beneath the diaphragm that may be identified. Sometimes a bronchogram, or the injection of iodized oil into a sinus leading to an inadequately drained abscess, will demonstrate the fistulous tract, but in other cases the tract is filled with pus and will not allow passage of the oil. In addition, the characteristic roentgenologic findings of subphrenic abscess, such as an elevated and fixed diaphragm, obscuration of the costophrenic angle, *etc.*, may be helpful when correlated with the clinical findings.

Mortality.—The mortality in the entire 48 cases of subphrenic abscess reviewed was 50.8 per cent as compared with 50.0 per cent in those cases complicated by bronchial fistula. Death in our three fatal cases occurred nine

days, 16 days and eight years, respectively, after rupture of the abscess into the bronchus, the last patient dying of a brain abscess which occurred as a complication of an osteomyelitis of a rib incident to drainage of the abscess which, in itself, had been entirely healed for three months prior to death.

No accurate comparison of the mortality rate in our series and that of the collected series can be made, inasmuch as many of the cases collected by Cauderay and Piquand, which constitute a large majority of the collected series, were not diagnosed before the patients came to autopsy. Many of the cases reported by these two authors occurred before surgical drainage of a subphrenic abscess was a widely practiced procedure. In every one of our cases drainage of the abscess was performed.

Treatment.—The prevention of a bronchial fistula is evidently concerned with the early diagnosis and drainage of the abscess.

Spontaneous recovery following rupture into a bronchus has been reported.[2, 3, 5] Cauderay, in reporting three cases of recovery without surgical drainage of the abscess, advises against conservative treatment because of the protracted convalescence. One of our cases (Case 2) was treated expectantly for two years but drainage was eventually found to be necessary because of recurrence of purulent sputum.

We advise immediate surgical drainage of the subphrenic abscess as the method of choice in the treatment of this complication. Drainage must be adequate. In two of our cases (Cases 1 and 6), inadequate drainage of the abscess was instituted following rupture into the bronchus. In both of these cases, the fistulous tract remained open until adequate drainage was established. An accompanying empyema should be drained independently.

CASE REPORTS

Case 1.—H. M., laborer, age 39, was first admitted to the University Hospital September 4, 1918. In April, 1918, an appendicectomy had been performed at another hospital for gangrenous appendicitis. Convalescence had been stormy and on the seventh postoperative day the patient began to expectorate thick, dark green pus having a very foul odor. On the fifteenth postoperative day, a large right subphrenic abscess had been drained. The patient, however, had continued to expectorate a considerable amount of pus. Twelve weeks after the appendicectomy, bismuth paste was injected into the abscess and was immediately vomited. The drainage tube was removed at this time. The patient was not then raising any appreciable amount of sputum.

Upon admission to the University Hospital, five months after the appendicectomy, the patient was again raising a considerable amount of sputum and complained of severe abdominal pain. A tumor mass was palpated below the right costal margin anteriorly. A roentgenogram revealed radio-opaque material evidently within the subphrenic abscess.

On September 9, 1918, an anterior subphrenic abscess was drained through a high right rectus incision. A large amount of thick, foul, yellowish pus together with some bismuth escaped. The patient was discharged November 4, 1918, with the wound still draining.

This patient was readmitted July 5, 1935, and stated that he had been raising thick, yellow, purulent sputum during the entire 17 years since his previous admission. In the interim, the mass in the right upper quadrant had recurred on several occasions, subsiding, however, following evacuation of pus by bowel. Two weeks before admission, a

fluctuant, superficial mass had appeared in the midepigastric region. This had been incised by his family physician with the evacuation of a moderate amount of pus.

Examination revealed two draining sinuses, one at the level of the eighth rib in the right midaxillary line, and the other in the midepigastric region. Roentgenograms, taken after the injection of iodized oil into the sinus of the right thoracic wall, revealed an irregular and tortuous tract which was seen to extend downward to end in a blind pouch and upward to communicate with a tertiary bronchus of the middle lobe. Stereoscopically, the lower tract appeared to be very superficial and extended in the direction of the recently opened abscess in the epigastrium. There was a faint shadow approximately midway between the thoracic wall sinus and the abscess in the epigastrium. This shadow was believed to be cast by the bismuth paste which had been injected in 1918.

The sinus tract between the axillary and epigastric sinuses was excised in four stages, between July 12, 1935, and January 8, 1936. The right chondral arch was removed and a pocket found which was believed to be the residual subphrenic abscess. A modified Schede thoracoplasty was performed and the lung cauterized in the region of the bronchial fistula. Convalescence from the last stage was complicated by mild cardiac decompensation which, however, was adequately controlled by digitalis. The patient was discharged March 3, 1936, at which time the wound was slowly filling with granulation tissue. All sinuses were entirely healed in July, 1936.

Case 2.—M. D., farmer, age 28, was admitted to the University Hospital August 24, 1926, complaining of cough with expectoration of large amounts of pus. Fourteen months previously, he had had an appendicectomy for acute appendicitis at another hospital. The postoperative course had been stormy, fever persisting for eight weeks. A rectal abscess had been drained several weeks after the appendicectomy. The patient had never fully recovered his strength and had had persistent tenderness in the right upper abdomen. Two days before admission, he had had a sudden coughing attack and had expectorated about a pint of foul, grayish-brown pus within a few minutes.

Upon admission the patient's temperature was 102° F. and he was coughing continuously. There was marked tenderness on palpation between the costal margin and the crest of the ilium on the right side. Roentgenograms showed a triangular density at the base of the right lung extending from the hilum to the diaphragm. A fluid level was noted in the lateral projection beneath the diaphragm, and a bronchogram demonstrated a tract leading through the diaphragm to this fluid level.

The patient was placed on postural drainage and became afebrile five days after admission. Cough and sputum had ceased after one month and he was discharged.

He was readmitted two years later, on August 25, 1928. In the autumn of 1927, he had had severe interscapular pain followed by recurrence of the cough and sputum which had continued for two weeks. At the time of readmission, he complained of recurrence of the interscapular pain and believed that his purulent sputum was about to recur. On the day after readmission, a right subphrenic abscess was drained through a posterior incision. The cavity was found to extend from a diaphragm down to the brim of the pelvis. Postoperative irrigation of the abscess cavity was discontinued because the patient complained that he tasted the irrigating solution. Convalescence was otherwise uneventful and the wound healed rapidly.

Case 3.—F. M., laborer, age 29, had been treated by the Department of Internal Medicine of the University Hospital for diabetes mellitus from May 26, 1930, until July 21, 1930. Blood Kahn test at that time had been found to be one plus and a history of previous antisyphilitic therapy had been obtained. He was discharged with the diabetes well controlled by dietary measures.

Upon readmission December 27, 1930, the patient complained of cough and pain in the left side of the chest. These symptoms had been present for five days. There was no history of abdominal pain. On examination he was found to be moderately dyspneic. Temperature was 101° F. Flatness to percussion and absent breath sounds were noted below the sixth rib posteriorly on the left. A roentgenogram of the chest showed ob-

scuration of the left costophrenic angle and the lower half of the left lung field up to the level of the fourth interspace anteriorly with an upward curve in the axilla. On fluoroscopy the left hemidiaphragm was found to be elevated and fixed.

Three days after admission the temperature rose to 103° F., pulse 130, respirations 30. Thoracentesis of the left chest yielded sanguinopurulent material, culture of which subsequently showed a Streptococcus hemolyticus. At this time the patient was raising an average of 120 Gm. of mucopurulent sputum daily, a stained specimen of which showed relatively few pus cells but many cocci. The patient's general condition seemed to improve somewhat during the next few days.

On January 8, 1931, 13 days after admission, he suddenly coughed up over 100 Gm. of extremely foul yellow pus which was similar in appearance to that obtained on thoracentesis ten days previously. Following this incident, the temperature became practically normal. During the next week, the quantity of sputum ranged from 200 to 350 Gm.

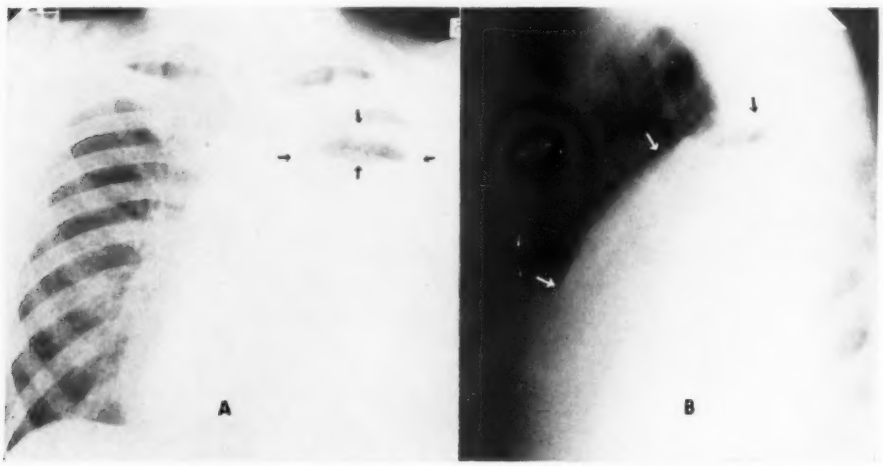

FIG. 1.—(Case 3.) Roentgenograms of chest 13 days after rupture of subphrenic abscess into bronchus. (A) Postero-anterior view. Marked elevation of left hemidiaphragm (indicated by upper arrow). Air bubble and fluid level in abscess cavity (lower arrows). (B) Left lateral view. Contour of elevated hemidiaphragm well demonstrated (arrow indicates dome of diaphragm). Air bubble and fluid level in abscess cavity.

On January 18, 1931, the temperature again began to rise and the patient became dyspneic and cyanotic. Roentgenograms of the chest (Figs. 1A and B), January 21, 1931, showed a marked elevation of the left hemidiaphragm with an air bubble and fluid level in the abscess cavity.

On January 24, 1931, under local anesthesia, a portion of the ninth rib in the posterior axillary line was resected. A large subphrenic abscess was found, the spleen being palpable inferiorly. The abscess cavity was packed with gauze, and a thoracentesis performed in the fourth interspace in the posterior axillary line, and pus was obtained which appeared to be identical with that obtained from the subphrenic abscess. This pus was evidently obtained from an undrained pocket of the abscess.

The immediate postoperative condition of the patient was satisfactory. Eight hours postoperatively symptoms of a severe acidosis were evident. These, however, were adequately controlled by insulin and glucose. Five hours later the patient suddenly died. The cause of death was not determined as permission for autopsy was refused.

Case 4.—T. M., laborer, age 30, was admitted to the University Hospital November 23, 1933, complaining of abdominal pain of four days' duration. A diagnosis of generalized peritonitis was made and the patient was placed on the Ochsner regimen. The temperature, which had been 102° F. upon admission, subsided satisfactorily. On the

tenth day of hospitalization, however, it rose to 103° F. following a chill. On the fifteenth day, the patient complained of pain beneath the right costal margin.

A roentgenogram of the chest (Fig. 2) the next morning demonstrated an air bubble and fluid level beneath the right hemidiaphragm as well as a moderate pleural effusion. That afternoon the patient had a sudden coughing attack and expectorated a large quantity of foul, sanguinopurulent material. He was immediately taken to the operation room and a large right subphrenic abscess was drained through an anterior incision. A small perforation of the diaphragm was noted at operation. Convalescence was stormy.

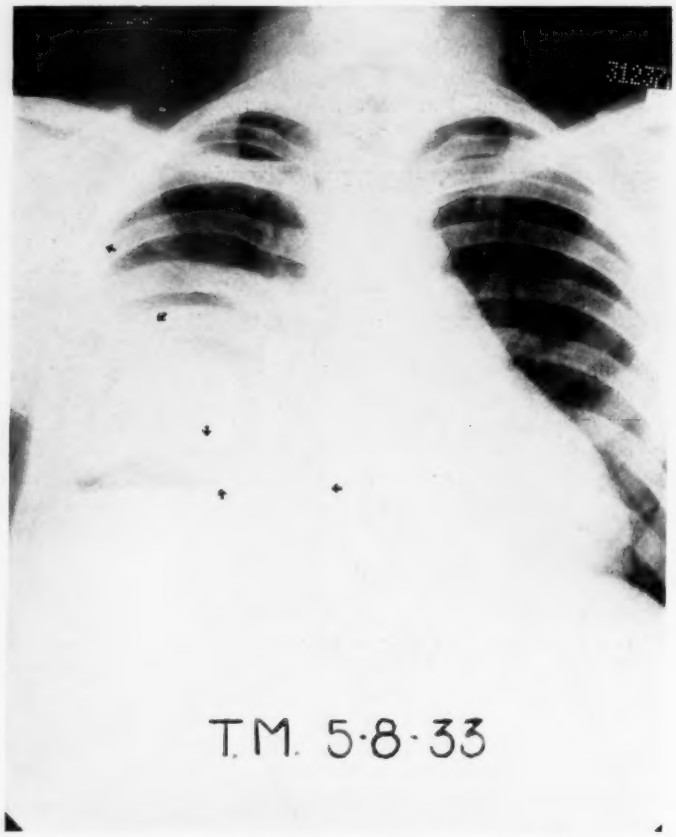

FIG. 2.—(Case 4.) Roentgenogram of chest five hours before rupture of subphrenic abscess into bronchus. Upper arrows indicate upper level of a pleural effusion. Lower arrows indicate dome of diaphragm and fluid level in subphrenic abscess cavity.

A loop of small bowel herniated into the wound on the first postoperative day and was replaced. The patient continued to raise a moderate amount of foul sputum. On the thirty-ninth postoperative day an additional pocket of pus was found anteriorly and drained. Following this procedure, convalescence was uneventful and the sputum became negligible in amount.

The sinus was still draining in August, 1933. A roentgenogram of the chest showed a considerable amount of pleural thickening at the base of the right lung, but there was no evidence of empyema. An appendicectomy was performed August 7, 1933. Ten days later, the sinus tract was explored and a residual cavity with thickened walls was found above the liver. This was drained through a large, stiff rubber tube. Postoperative irrigation of the cavity resulted in the expectoration of a small amount of mercurochrome

which had been used as the irrigating fluid. Convalescence was otherwise uneventful and the wound had practically healed at the time of discharge, January 10, 1934.

Case 5.—J. B., Negro, laborer, age 48, was admitted to the University Hospital October 2, 1934, complaining of two draining abdominal sinuses. Appendicectomy had been performed at another hospital for acute appendicitis six months previously. This wound had never completely healed. A right subphrenic abscess had been drained two months after the appendicectomy and this had also continued to drain.

Examination upon admission revealed extreme emaciation. A fecal fistula was present in the right lower abdominal quadrant at the upper end of a scar. The eleventh rib in the right midaxillary line had been resected and there was a sinus at this site, drainage from which was also fecal in character. Injection of the upper sinus with

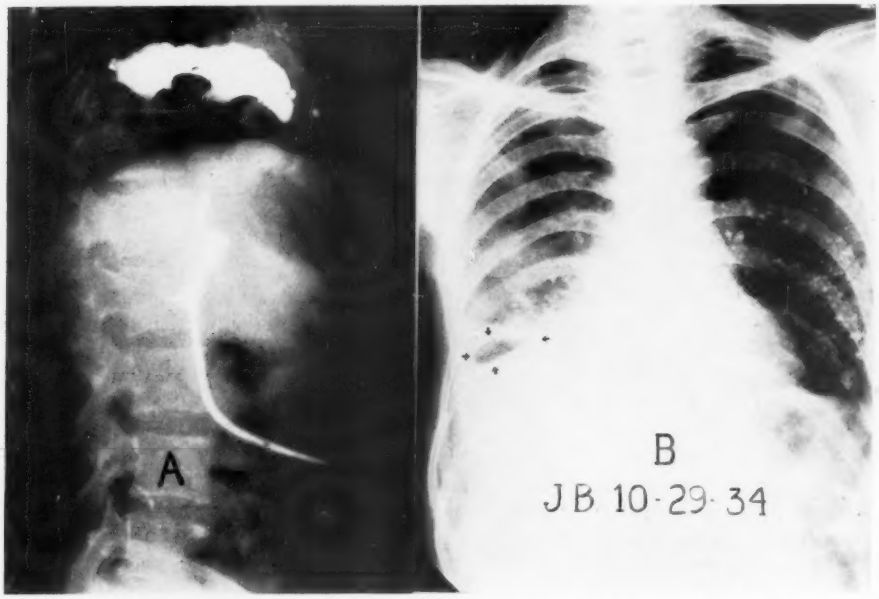

FIG. 3.—(Case 5.) (A) Right lateral roentgenogram of upper abdomen following injection of iodized oil into inadequately drained subphrenic abscess. Elevated right hemidiaphragm over abscess not shown but normal left hemidiaphragm well demonstrated. Roentgenogram of chest on same date demonstrated no communication with bronchus. (B) Roentgenogram of chest nine days later and one day after rupture of subphrenic abscess into bronchus. Iodized oil previously injected into abscess cavity now distributed throughout both pulmonary fields. Arrows indicate subphrenic abscess cavity.

iodized oil demonstrated a persistent subphrenic abscess (Fig. 3A). No oil was seen in the pulmonary fields. A barium enema revealed a fistulous tract between the lateral margin of the right colon and the draining sinus in the right lower quadrant.

On October 23, 1934, the right posterior subphrenic space was explored after resection of the twelfth rib. No pus or oil was found. On the fifth postoperative day, the patient had repeated hemoptyses followed by the expectoration of a large amount of foul sputum. A roentgenogram on the following day (Fig. 3B) showed a small residue of iodized oil with a fluid level and air bubble beneath the right hemidiaphragm, and iodized oil was seen to be distributed throughout both pulmonary fields. Pleuritis and pneumonitis were noted at the base of the right lung.

The right anterior subphrenic space was explored November 1, 1934. Again no abscess was found, but a fecal fistula involving the ascending colon was closed. The patient died five days later of bronchopneumonia.

Autopsy.—A small subphrenic abscess was found posteriorly. There was a perforation through the right hemidiaphragm which easily admitted a finger. Above the perfo-

ration was a small localized empyema pocket, the pleurae being densely adherent except at this point.

Case 6.—J. G., male, bricklayer, age 43, was admitted to the University Hospital September 6, 1935, complaining of the expectoration of large amounts of purulent sputum. Seven years previously he had developed severe abdominal pain which had subsided without operative intervention. Two weeks after the onset of this pain, he suddenly began to expectorate a large amount of foul, purulent sputum. Two weeks later an abscess was drained through an incision below the twelfth rib in the right posterior axillary line. Drainage from the abscess ceased after a few weeks, but the cough and sputum persisted.

For four years prior to admission the patient had been receiving bronchoscopic aspirations at regular intervals. Autogenous vaccines, prepared from the secretions of the paranasal sinuses, had been administered, and tonsils and teeth had been removed as possible foci of infection. No relief had been obtained from these measures.

Examination upon admission revealed the patient to be in relatively good general condition. There was a right chronic otitis media. Percussion note was impaired and breath sounds were distant at the base of the right lung both anteriorly and posteriorly. Marked hypertrophic osteo-arthropathy was present.

During the first week of hospitalization, the temperature ranged from normal to 102° F., with daily elevations to at least 100° F. Sputum was mucopurulent in character and varied from 55 to 350 Gm. a day in quantity.

A roentgenogram of the chest revealed chronic pneumonitis in the inferior division of the right posterior lobe and the middle lobe, with obliterative pleuritis in the right axillary region. The right hemidiaphragm was elevated and fixed. A bronchogram showed a localized saccular dilatation of a tertiary bronchus in the anterior portion of the middle lobe. No iodized oil was seen below the level of the diaphragm.

Bronchoscopy, September 12, 1935, revealed that the secretions were draining into the right stem bronchus and were coming chiefly from the right middle lobe orifice.

On September 19, 1935, an exploratory thoracotomy was performed, portions of the fifth and sixth ribs being resected for a distance of 7 cm. laterally from the costal cartilages. The pleura was found thickened and the lung adherent. The lung was incised and the pulmonary tissue found to be atelectatic and considerably fibrosed. A fistulous tract was entered at a depth of about 2 cm. which, superiorly, communicated with a bronchus. The tract was followed inferiorly and found to enter a small empyema pocket which, in turn, communicated with a subphrenic abscess, extending below the diaphragm for a distance of 10 cm. The opening in the diaphragm was estimated to be about 1 cm. in diameter. This was dilated and a large rubber tube inserted for drainage.

The immediate postoperative course was uneventful. By the fourteenth postoperative day the sputum was negligible in amount and the temperature was normal. The bronchopleurocutaneous fistula resulting from the incision of the sinus tract closed spontaneously in seven weeks. The subphrenic abscess granulated rapidly and was completely obliterated 11 weeks after operation.

The wound, however, remained open due to an osteomyelitis of the stump of the sixth rib. A small portion of this rib was resected October 24, 1935. Because of an extension of this process, 12 cm. of the same rib were resected January 15, 1936. The wound became grossly infected following this procedure, although the infection became well localized by the fourteenth postoperative day. Convalescence was thereafter uneventful until one month postoperatively, when the patient suffered a sudden attack of unconsciousness, lasting about one hour. During the next few days, he became increasingly more drowsy and disoriented, finally becoming comatose, and died February 21, 1936.

Autopsy.—The cause of death was determined to be a brain abscess, located in the left frontal lobe. The right pleural cavity was obliterated by adhesions. All lobes of the right lung showed patchy areas of atelectasis and chronic fibroid pneumonitis. The perforation of the right hemidiaphragm had healed completely. There were many dense

adhesions over the superior aspect of the right lobe of the liver, but no evidence of any residual subphrenic abscess was found.

TABLE II

CASES OF SUBPHRENIC ABSCESS WITH BRONCHIAL FISTULA REPORTED IN THE LITERATURE

Author	Year	Total	Mortality Per Cent	Cases with Bronchial Fistula			
				Number	Per Cent of Total	Died	Mortality Per Cent
Cauderay*	1902	—	—	20	——	16	80.0
Barnard*	1908	76	47	4	5.3	?	?
Piquand	1909	890	60	112	16.4	76	67.5
Ross	1911	31	33	1	3.2	1	100.0
Ullman and Levy	1920	—	—	1	——	0	0.0
Dexter	1927	6	33	1	16.6	0	0.0
McNamee	1930	15	33	1	6.6	0	0.0
Schwartz	1930	8	50	1	12.5	1	100.0
Beye	1932	31	39	6	19.3	?	?
Ochsner and Graves	1933	50	32	1	5.0	0	0.0
Overholt and Donchess.	1935	25	32	1	4.0	1	100.0
Steele	1936	48	50.8	6	12.5	3	50.0

* Included in Piquand's series.

SUMMARY.—(1) Perforation of the diaphragm by a subphrenic abscess with subsequent rupture into a bronchus is a somewhat rare occurrence.

(2) The literature on this subject is reviewed and six additional cases are presented.

(3) The incidence of this complication rises with delayed diagnosis and treatment.

(4) The mortality of 50 per cent in our series of six cases was approximately the same (50.8 per cent) as in our general series of 48 cases of subphrenic abscess.

(5) The diagnosis may be difficult to establish.

(6) Surgical drainage of the subphrenic abscess is advised as the treatment of choice.

In the fourteen months from January 1, 1936, to March 1, 1937, ten additional cases of subphrenic abscess were admitted to the University of Michigan Hospital. Two of these were complicated by bronchial fistula. Both patients are living.

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DRAINAGE OF THE ABDOMINAL CAVITY IN OPERATIONS FOR PERFORATED PEPTIC ULCER *

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PRESUMABLY, in a discussion of this question, the viewpoint taken ought to be one which offers the best hopes of recovery to the greatest number of patients. Inevitably in the most serious surgical emergencies, conditions surrounding the operation frequently fall far short of the ideal. Many of the operations will be performed by a junior surgeon, and as there are few questions in abdominal surgery requiring greater nicety of decision than that of when, and how, to drain, it would seem on the face of it that it were better to say "when in doubt, drain" rather than "when in doubt, do not drain." There is no unanimity of opinion, however, concerning the advisability of drainage of the abdominal cavity in operations for perforated peptic ulcer.

Many operators never drain because it appears that drainage accomplishes little, stating that adhesions soon form around the drain and in a few hours possibly it drains but a small area. In spite of this it is certain that a wide area of the abdomen is drained. This is especially true in the first few days after operation, when the inflammation is still marked and the voluminous exudate prevents peritoneal adhesions. Adhesions, between structures surrounding the drain, develop only as the inflammation is reduced in severity. At this time also comes the reduction in the area which is affected by the drain.

Many experimentators, Buchbinder, *et al.*, have attempted to prove by animal experimentation that a drain will act only for a very few hours in suppurative peritonitis in dogs. This statement I do not think will apply to the peritonitis under discussion. In perforative peptic ulcer the abdomen is filled with a flood of gastric and duodenal digestive substances which in themselves will, and do, tend to prevent the formation of adhesions. Despite the high incidence of positive cultures obtained in these cases, rarely in the first hours do we see even filamentous adhesions but rather excessive cloudy fluid throughout the entire abdomen. When adhesions do form it means that the drain has done its duty and should be removed. It is astonishing the change that follows drainage in these cases. The board like abdomen becomes soft, pliable and insensitive within a few hours.

Donald Guthrie, in 1923, sent out a questionnaire in which surgeons all over the country were asked whether they employed drainage in these cases. One hundred and one replied that they did so in all cases. Five men usually did, and 18 drained only occasionally. There were 13 surgeons who stated

* Read before the Philadelphia Academy of Surgery, March 4, 1936. Submitted for publication June 27, 1936.

that they did not employ drainage at all. Although the ensuing 12 years may have brought about some change in opinion, it has not brought agreement, as even a brief perusal of the current literature will show. Series of cases of perforated ulcer form a rather favorite topic for reports. Few are available for this discussion, however, as most authors treat the question of drainage in a rather cursory manner. Our preference is for the routine drainage of these cases, a preference which we cannot support statistically. In the available reports, difference of opinion lies chiefly in the management of the early cases, perforated less than 12 hours before operation. A number of surgeons, ourselves included, favor drainage as a routine in these cases. A second group oppose drainage on theoretic grounds, but in practice drain a large proportion of their cases. A third group employ primary closure in early cases, although they drain the late ones in which there is much soiling. A comparison of the mortality statistics of these three groups seems to argue against the practice of drainage (Table I).

TABLE I

MORTALITY STATISTICS OF DRAINAGE IN ALL CASES

	Cases	Mortality—Under 12 Hours
Brown, H. P., Philadelphia	100	28.0%
Starbuck, Mt. Sinai, New York City	88	13.0%
Williams and Walsh, England	158	20.0%
Eliason and Ebeling, Philadelphia	74	26.0%
Total	420	21.75%

MORTALITY STATISTICS OF SURGEONS WHO DRAIN FREQUENTLY

	Cases	Mortality—Under 12 Hours
McCreery, Bellevue	25	6%
Corvose, Providence	106	20%
Bryce, Manchester, England	154	10%
Total	285	13%

MORTALITY STATISTICS OF SURGEONS WHO DRAIN ONLY LATE CASES

	Cases	Mortality—Under 12 Hours
Semb, Sweden	166	8.0%
White and Patterson, Roosevelt	79	6.0%
Gibson, New York Hospital	123	12.0%
Gilmour and Saint, England	64	2.0%
Bager, Sweden	88	9.0%
Total	520	7.4%

SUMMARY

	Mortality—Under 12 Hours	13–24 Hours
Drain all cases	21.75%	60%
Drain frequently	13.0%	40%
Drain only late cases	7.4%	27%

The problem, however, is not so simple that it can be answered by quoting mortality statistics. Doctor Ebeling and the author collected the data from 70 reporters, totaling 5,061 cases of perforation in this country and abroad, and found the mortality approximately 24 per cent. It was interesting to

note that in these 70 reports the mortalities ranged from zero to as high as 60 per cent. It was also noticed that the zero men reported never over 15 cases, usually under ten. But little could be found concerning drainage.

It is a mistake to compare statistics. As has been stated, statistics are of value only to the man making them. Until all writers use the same language, so to speak, comparisons are inconclusive. One writer's mortality figures are based on the premise that a surgical death must happen in seven days and be directly due to the surgical condition. If the patient dies of pneumonia three weeks later, it is not a surgical death. This diversity of time limit is known to range from 48 hours, entire hospital stay, days, weeks or even months. Two of our cases, for example, died on the thirty-ninth day and the forty-eighth day, respectively.

If only an occasional case might be saved by the institution of drainage, we are in favor of it. It is significant, we believe, that, although there is much talk about drains being unnecessary, there are no definite records of cases in which the insertion of a drain for a few days has done harm. Prolonged abdominal drainage in these cases as elsewhere may favor the development of intestinal obstruction, but prolonged drainage is not required or suggested for perforated ulcer.

Our contention is that after the surgeon has dealt with the perforation itself he must recognize and deal with an infection, actual or imminently threatened. Drainage is fundamental to the treatment of infection. The fact that drainage of the peritoneal cavity cannot be accomplished as effectually as elsewhere, and that the peritoneum itself is astonishingly efficient in combating infection, does not excuse the surgeon from attempting to aid nature.

It is often argued that the contents of the upper gastro-intestinal tract which escape through a perforation are sterile. Careful bacteriologic examinations do not bear this out. Such positive findings as are obtained carry more weight than innumerable negative cultures (Table II).

TABLE II

BACTERIOLOGIC REPORTS

	Time	Positive
Brütt	Under 12 hours	74%
	Over 12 hours	93%
McCreery	Under 10 hours	50%
Eliason and Ebeling	Under 12 hours	80%
Bartle and Harkins	"	79%
Watson	"	81%

Among the organisms reported are Staphylococcus hemolyticus albus, Streptococcus viridans, nonhemolytic Streptococcus and *B. coli communis.*

A further argument for drainage lies in the common cause of death in this condition. It is not intestinal obstruction or any other condition which might be aggravated or precipitated by the use of drainage. It is a condition which conceivably may be helped or prevented by drainage, namely, peritonitis. A further peculiar feature about this type of peritonitis is that death occurred in our cases usually in three to four days after operation, whereas

in cases of suppurative peritonitis due to lower bowel perforation, appendicitis, *etc.*, death does not ensue, as a rule, until after five to eight days. Table III refers to diffuse peritonitis only. If there are added the deaths due to septic sequelae (subphrenic abscess, pylephlebitis, liver abscess, empyema), the figure will be considerably increased.

TABLE III

PERCENTAGE OF DEATHS IN CASES OF DIFFUSE PERITONITIS

	Number of Cases	Percentage of Deaths
General peritonitis	398	59.0%
General peritonitis + shock	13	2.0%
General peritonitis + pneumonia	4	
General peritonitis + evisceration	5	
Subdiaphragmatic abscess	33	4.9%
Intestinal obstruction	8	
Cardiac (sepsis?)	31	4.6%
Shock (sepsis?)	29	4.3%
Table (sepsis?)	6	
Pulmonary complications	103	15.3%

As to the type of drainage used, our preference is for drainage of the site of perforation by a soft cigarette drain through a stab puncture at a dependent point and a similar drain laid laterally between the liver and diaphragm if infective material is found there. Fleming recorded subdiaphragmatic abscesses in three cases of upper abdominal drainage. Richardson mentions a similar occurrence. McGlannan and Bongardt also had three deaths from abscesses in this region, and now they drain this area. In addition, in cases with extensive contamination, especially if there is a collection in the pelvis, one of us (E. L. E.) has been impressed with the amount of material which is discharged upon the dressings for several days from a suprapubic drain placed into the pelvis. If the patient does well, and drainage is slight in amount, the drains may be removed in 48 to 72 hours. The circumstances of the case may sometimes call for the use of additional drains in the subphrenic or subhepatic areas. We regard the choice of a particular type of drainage as a matter of individual preference and as distinctly secondary to the main decision as to the employment or nonemployment of drainage of the abdomen.

In our last 18 cases the operative mortality was 11.1 per cent; the incidence of positive culture was 80 per cent. Four of the five positive culture cases recovered, and all but two of the total number of cases were drained, which would compare favorably with the percentages of the nondrainage advocates.

Comment.—Although collected statistics do not bear us out, we are inclined to think that, other things being equal, similar comparisons, *etc.*, drainage of the peritoneum after perforation of a peptic ulcer saves more lives than closure without drainage in the hands of the same surgeon. We have found no evidence to prove that drainage is responsible for the increased mortality published by the advocates of this principle. I do not think we have as yet solved the problem.

MULTIPLE POLYPOSIS OF THE COLON

A FAMILIAL DISEASE

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LOCKHART-MUMMERY,[3] in 1934, presented three striking instances of the familial occurrence of "Adenomatosis of the Colon." This disease, occurring in families, is as truly inherited as Friedreich's ataxia or hemophilia, and as Lockhart-Mummery says, "a change, or mutation has taken place in the genes of some individual who has not personally exhibited the diseased condition, but who has passed the mutated genes on to his descendants." Again he states, "When a mutation of the genes has taken place, the results may appear in succeeding generations either as dominants or recessives. If as a dominant the condition will tend to occur in every generation, but if the disease is a recessive it will only be seen when both parents carry the mutative genes which may not occur for very many generations, and then the hereditary factor is very likely to be missed."

Lockhart-Mummery presented three very interesting charts. The families were three in number, two which came under his own observation and one taken from Zahlmann. The three groups may be briefly summarized as follows:

Case 1.—(L.-M.) A woman, who died at 42 of cancer of the rectum, had nine children, of whom seven died of the same condition. One son who developed cancer of the rectum married a healthy woman who bore him three children, of whom two had adenomatosis of the colon. Another son, who also had cancer of the rectum, had four children, of whom two had adenomatosis of the colon, one of whom developed cancer of the rectum, of which he died.

Case 2.—(L.-M.) A man and woman, both of whom developed cancer of the rectum, had ten children, of whom four died of the same disease. One of these four had six children of whom two had adenomatosis of the colon, one of the latter developing cancer of the rectum, from which he subsequently died.

Case 3.—(Zahlmann.) A man who died of cancer of the rectum had two children, one a male who developed adenomatosis resulting in cancer of the rectum, and subsequent death. By his wife he had four children, all of whom developed adenomatosis of the colon, and one of these had cancer of the rectum and died. This same wife had, by another husband, two healthy children who never developed the disease.

Hullsick,[2] in 1928, collected from the literature 127 cases of polyposis of the colon, of whom 46 (36 per cent) developed cancer and of whom 11 per cent showed a positive familial history. He reported an instance of two brothers with polyposis, sons of a father who died of "bowel trouble." He referred to Duke's three cases, in all of which there was a striking example of familial occurrence of cancer or polyposis of the colon or rectum. Barker,[1]

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in 1930, emphasized the familial occurrence of polyposis and spoke of it also as a precancerous condition. He had a male patient with polyposis of the colon, in whose family he found, with the same disease, a grandmother, great grandfather, and among the aunts and uncles (and great aunts and uncles), eight more cases; 11 in four generations of the same family.

Rankin,[4] in 1935, read a report, supplementary to a previous one in 1931, presenting three more cases of polyposis. One was a girl of 19 with no significant family history; the second a woman of 32 with polyposis, whose mother had died at 32 of the same disease; and the third a woman of 28, who had a brother and sister suffering from the same condition.

Inasmuch, therefore, as polyposis of the colon may thus be a familial disease, and is a definitely precancerous lesion, we may say that in this one condition, at least, we have positive evidence of the rôle that may be played by heredity in the development of cancer. In order to emphasize the familial aspect of the disease, as a matter of biologic interest, the following two case reports are cited.

Case 1.—Male, age 32, police officer. Two brothers living and well, one sister living (Case 2).

Family history negative except that father died of some wasting disease which caused him to go repeatedly to the toilet and pass small bloody movements (one might reasonably consider this to have been cancer of the rectum). Previous history not significant.

He entered the Massachusetts General Hospital December 27, 1932, with a history of frequent, soft bowel movements, with an excessive amount of flatus.

Proctoscopy showed multiple polyps of the rectum and lower sigmoid, and also a definite carcinoma of the rectum, which biopsy proved to be an adenocarcinoma Grade 2.

Roentgenologic Examination.—"There is definite delay in the passage of barium through the rectosigmoid, which is narrowed and definitely irregular. The irregularity is apparently produced by numerous polypoid masses. The narrowing may be due to these polypoid defects, but there appears to be an organic constriction also. In addition to the polypoid filling defects in the rectosigmoid, similar defects are seen in the entire descending colon, sigmoid and rectum. Smaller and less distinct filling defects are seen in the transverse colon. No definite polyps are demonstrated in the cecum."

Operation.—January 7, 1933. Combined abdominoperineal resection of sigmoid and rectum. An artificial anus was made by pulling out the lower end of the upper sigmoid segment through a stab wound in the left side of the abdomen. Convalescence from this operation was uneventful and the patient was discharged February 8, 1933.

Pathologic Report.—"Fifty-two cm. of large bowel with rectum and anus and underlying mesentery. Fifteen cm. from the anus is a constricting ulcerated mass 6 cm. in length. The edges of this mass are elevated about 4 Mm. On section this mass extends throughout the wall. Scattered on the mucosal surface of the remaining portion of the bowel are found numerous pedunculated reddish cauliflower-like polyps, the largest of which measures 3 cm. in diameter and is located 2 cm. from the large tumor mass. Several of the other polypi show ulcerated surfaces. The polypi extend to the extreme margin of the resection. Several involved nodes are found in the mesenteric fat." *Diagnosis:* "Adenocarcinoma Grade 2, with metastases to the regional nodes. Polyposis coli."

As it was realized that the patient had numerous other polypi, he was advised to have the remainder of his colon removed. He returned to the hospital April 11, 1933, for this procedure. The remaining colon, with a short segment of terminal ileum, was removed, and an ileostomy performed.

Pathologic Report of second specimen.—"Four cm. of terminal small bowel and 104

cm. of large bowel. The serosal surface is smooth. The mucosa is sprinkled with small polypi, some of which are pedunculated. The largest polyp measures 0.7 cm. in diameter. There is an even distribution of polypi in all portions except the cecum, which contains relatively few. The polyps are all soft and none of them appear to be invasive at their bases. There is no apparent injection or ulceration of the remaining mucosa."

He left the hospital in good condition and, in spite of his ileostomy, continues his duties

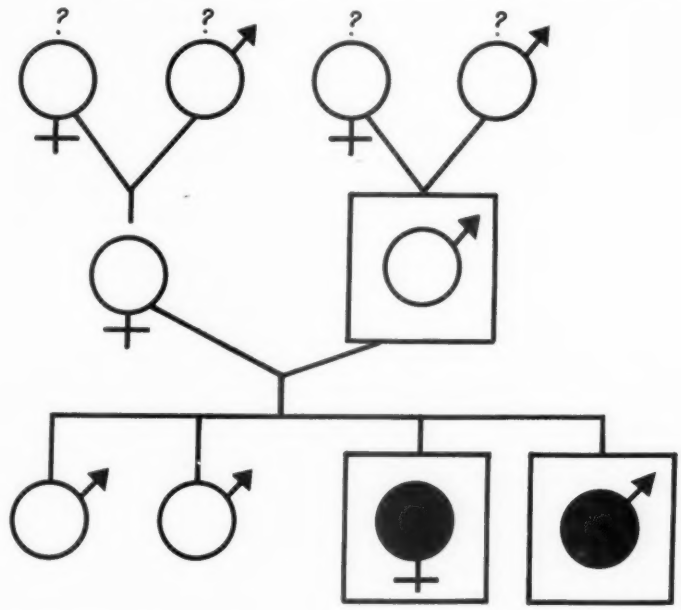

CHART 1.—Showing the pedigree of the two cases cited of familial polyposis of the colon.

as a policeman. His only complaint is occasional tightening of the skin and superficial tissues around the ileostomy opening, with consequent interference with free emptying of the bowel.

Case 2.*—Female, aged 23, sister of Case 1. First seen June 30, 1930, when she complained of having had moderate diarrhea, with occasional blood, for eight years. For this

* This case was under the care of one of us (R. H. S.) and Dr. Daniel F. Jones, to whom we are indebted for permission to report it.

condition she had two operations performed, an appendicectomy, and later a clamp and cautery procedure for hemorrhoids.

Proctoscopic Examination.—July 1, 1930. "The whole rectum was found to be covered with polyps from one-eighth to one inch long. Some were sessile and some pedunculated. One suspicious appearing lesion was in part removed for examination." This proved to be a malignant adenoma, Grade 3.

Operation.—July 10, 1930. A combined abdominoperineal removal of the sigmoid and rectum was performed. A definite carcinoma was found in the sigmoid (besides the one in the rectum). The pathologic report was "adenocarcinoma Grade 1, with hyperplasia of contiguous lymph nodes." The patient left the hospital in good condition August 24, 1930.

One month later she returned, and on October 11, 1930, the remaining colon was removed and a permanent ileostomy effected. It is interesting that there were absolutely no adhesions from the preceding operation. The pathologic report showed besides the polyps, another area of cancer, the third to be found. "The specimen consists of two pieces of large intestine, cecum and terminal ileum, measuring 71 and 36 cm. respectively, and also 6 cm. of ileum. Serosal surface negative. Entire mucosa of colon has adherent, numerous, soft, reddish, pedunculated polypoid masses varying from 0.5 to 4 cm. in diameter; the smaller ones are more proximal, the larger ones more distal. In the lower portion of the colon, 8 cm. from the distal end, is a somewhat firmer flattened polypoid mass 3 x 5 cm. in dimensions. Section shows pale gray tissue somewhat fixed to the muscle. Several small polypi around ileocecal valve and three small ones, 0.5 cm. in diameter, adherent to mucosa of ileum." *Microscopic Diagnosis:* Adenocarcinoma, Grade 1. Multiple mucous and adenomatous polypi.

The patient did fairly well until, on July 2, 1931, an operation became necessary for acute intestinal obstruction. This procedure revealed three interesting findings: First, an almost entire absence of adhesions; second, a still functioning omentum, and third, a volvulus of the terminal ileum. The volvulus was untwisted and a temporary tube ileostomy effected, following which she recovered without untoward event.

It took more than a year for the posterior wound to heal.

In November, 1932, another operation was performed for the removal of a tumor nearly the size of a hen's egg at the lower end of the left abdominal scar. This was naturally thought to be a local recurrence of the cancer. The examination revealed, however, that the "Specimen consists of a piece of tissue 5 x 7 x 4 cm. covered on one surface by a piece of skin. The skin contains a linear scar 6 cm. long. On opposite side of tumor is a portion of striated muscle. On section the tumor mass is rounded, apparently encapsulated, measures 3 cm. in diameter. Semifirm in consistency, and not attached to skin or underlying muscle. Cut surface pink, moist, and bulging. One linear area extending from margin across two-thirds of tumor mass is white and firmer than surrounding tumor tissue." *Microscopic Diagnosis:* Fibrosarcoma, desmoid type.

These two patients, brother and sister, are now comparatively well and free from any evidence of recurrence of cancer. Each presented a not uncommon postoperative complication of this type of radical surgery, namely, one had recurrent trouble from the scar tightening and constricting the ileostomy opening (Rankin mentions this also), and the other developed acute intestinal obstruction. One had a later desmoid tumor in the scar. This patient, the woman, had three definite and unconnected areas of cancer—one in the rectum and two in the sigmoid.

Rankin discusses the procedure, which he has followed successfully in one case, of retaining the lower sigmoid and rectum, after removal of the rest of the colon, destroying the polyps by fulguration, and later performing an ileosig-

moidostomy, thus obviating the necessity of a permanent artificial anus. In the absence of any suspicious malignant degeneration in the segment left in, such a course is certainly worthy of serious consideration.

CONCLUSIONS

(1) Multiple polyposis of the colon and rectum may be, and often is, a familial disease. In the study of any such case the family history should be carefully elicited.

(2) These polyps show a notable tendency to become malignant, and in this group of cases there is, indirectly, a definite familial occurrence of cancer in a circumscribed portion of the gastro-intestinal tract.

(3) Multiple polyposis of the colon and rectum is most safely treated by complete removal of the lower intestinal tube, from the terminal ileum to the anus.

(4) If the rectum and sigmoid have been removed for polyposis and cancer, and it is known that there are polyps in the remaining colon, the situation must be explained to the patient, and further radical removal must be urged.

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THE EVALUATION OF ABDOMINAL SYMPTOMS IN THE DIABETIC*

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THE proper evaluation of abdominal symptoms in a diabetic often presents a very puzzling problem. In this presentation we wish to discuss some observations made in a study of 1,260 consecutive admissions to the Diabetic Service, which indicate certain basic differences in the degree of severity of abdominal symptoms in diabetic acidosis and in acute abdominal conditions as they occur in the diabetic and nondiabetic patient.

It is of great importance for the surgeon to recognize and appreciate the symptoms of diabetic acidosis. Unfortunately, the terms diabetic acidosis and diabetic coma are linked together in the minds of many physicians and as a result, the symptoms expected in a case of acidosis are deep sighing respiration—increasing drowsiness merging eventually into deep coma. We feel, however, that these are terminal symptoms and there are other and more common symptoms which should be recognized and which are responsible for a surgeon being called in to see these patients. We refer to the abdominal symptoms; namely, nausea, vomiting and abdominal pain and tenderness which are usually associated with fever and leukocytosis. These are present in the vast majority of cases of acidosis before the comatose symptoms develop. In some patients they may be very severe and are responsible for the patient seeking medical attention.

The association of abdominal symptoms with diabetic acidosis had not been pointed out with sufficient clarity until relatively recently. Joslin,[1] F. N. Allan,[2] Joslin, Root and White,[3] and F. H. Allen[4] in recent articles pointed out this association. McKittrick[5] and Beardwood[6] emphasize the importance of these symptoms as early indications of the development of diabetic acidosis. The same group of symptoms and clinical findings is also characteristic of an acute abdominal condition and without a careful history, uranalysis, blood sugar, and plasma CO_2 determination, a differential diagnosis of these conditions may be impossible.

It is well to remember that diabetic acidosis seldom comes on suddenly, but usually develops over a period of 24 or 48 hours. The early symptoms are usually polyuria and polydipsia, but these may not be of sufficient severity to have attracted the attention of the patient. The acidosis usually develops rather gradually, but the abdominal symptoms may be of sudden onset.

In this series of 1,260 cases of diabetes there were 136 or 10.8 per cent cases of diabetic acidosis. Ninety-six or 74 per cent of the 136 cases showed, as the predominating symptoms, either nausea, vomiting or abdominal pain,

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whereas 40 or 26 per cent showed the central nervous system symptoms of drowsiness and coma. In those cases with abdominal symptoms, 85 per cent showed leukocytosis (white blood cells over 11,000) and 80 per cent had a fever (over 99° F.). The highest leukocyte count was 44,000 and the highest temperature was 104° F. (Table I).

TABLE I

CASES IN WHICH THERE WERE LEUKOCYTOSIS AND FEVER

	Cases with Abdominal Symptoms		Cases without Abdominal Symptoms		Total of Series	
	Number	Per Cent	Number	Per Cent	Number	Per Cent
Leukocytosis	82	85	23	58	105	89
Fever	77	80	16	40	93	68
Total cases in group	96		40		136	

The clinical appearance of patients suffering from diabetic acidosis is frequently not unlike that of acute intestinal obstruction in that they are toxic, markedly dehydrated, have abdominal distension, pain, nausea, vomiting and obstipation.

Case 1.—Mrs. W. S., age 44, was known to have had mild diabetes for some years and was rather careless in her control of the disease. The history revealed that this patient had been vomiting and suffering from obstipation for three days before admission to the hospital. Vague abdominal symptoms had been present for 24 hours, and 12 hours before admission a sudden severe pain developed in the upper right quadrant of the abdomen. Temperature, 103° F. Leukocyte count, 31,000. The diagnosis on admission to the hospital was acute intestinal obstruction. On physical examination, the patient was markedly dehydrated, had some tenderness and rigidity in the upper right quadrant of the abdomen. Uranalysis showed glycosuria, the blood sugar was 420 mg. per 100 cc. and the CO_2 was 17 volumes per cent. A diagnosis of diabetic acidosis was made and under proper management for this condition, the abdominal symptoms rapidly improved and six hours after admission the abdominal examination was negative and the nausea and vomiting had entirely disappeared.

Case 2.—A boy, age 13, was not known to have had diabetes. He developed a severe sharp pain in the lower right quadrant of the abdomen accompanied by nausea and vomiting. Temperature, 103.2° F. Leukocyte count, 29,000. He was sent to the hospital with a diagnosis of acute appendicitis. This diagnosis seemed justified in view of the symptoms. A preoperative uranalysis showed glycosuria. Blood studies revealed a blood sugar of 730 mg. per 100 cc. and a CO_2 of 15 volumes per cent. A more careful history was then obtained and it was learned that the child had been passing large quantities of urine and drinking large amounts of water for seven to ten days before admission. A diagnosis of diabetic acidosis was made and here again under proper treatment of this condition the fever, leukocytosis and abdominal symptoms entirely disappeared.

These two cases demonstrate the importance of a preoperative uranalysis whether the patient is or is not a known diabetic. This procedure is all the more important because of the increasing number of diabetics.

It is an accepted surgical dictum that no major surgical procedure should be performed upon a patient with impending or frank diabetic acidosis. The proper procedure is to treat the acidosis which can usually be controlled suf-

ficiently in three to six hours to permit of a diagnosis of any underlying abdominal pathology which might be present. If an acute abdominal condition is found, surgical intervention should not be undertaken until the acidosis is controlled as there are few cases in which the delay necessary to control the acidosis would increase the operative risk as much as it is increased by operating in the presence of this complication. Operations can be undertaken with a fair degree of safety with a blood sugar two or three times normal, provided the CO_2 is not below 40 volumes per cent, and we feel that no attempt should be made to lower the blood sugar below 150 mg. per 100 cc. of blood, immediately before operation. In our opinion, no surgery should be performed with a CO_2 of less than 40 volumes per cent, and if the emergency will permit, the CO_2 should be elevated to 45 or 55 volumes per cent.

The danger of operation upon a patient in the presence of diabetic acidosis is illustrated by the following case:

Case Report.—W. S., male, age 72, had had mild diabetes for some years. It was so mild that neither the patient nor his physician made any effort to control the glycosuria. He had suffered from abdominal pain and constipation for three days prior to admission to the hospital. The pain increased in severity and he began to vomit 24 hours before admission. The patient entered the hospital late at night and the history of diabetes was not obtained at that time. The patient seemed so ill, the abdomen was so greatly distended, and the clinical picture was so typical of intestinal obstruction that operation was performed at once. No obstruction was found at the operation. The blood sugar the following morning was 373 mg. and CO_2 was 12 volumes per cent, and in spite of intensive treatment the patient died six hours later of diabetic acidosis.

There is no satisfactory explanation for the abdominal symptoms in diabetic acidosis. The patients were studied for lesions of the gastro-intestinal and genito-urinary tracts after recovery from the acidosis and no conclusive evidence was found which would explain the abdominal symptoms. Nielsen,[7] Peters,[8] Lawrence, Lucas and McCance[9] and John[10] have all studied the cause of the leukocytosis in acidosis and have advanced ideas relative to the cause of its development. In our cases there was no direct relationship between the presence or degree of severity of the abdominal symptoms and the severity of the acidosis, the age or sex of the patient, the height of the blood sugar or the duration of the disease.

In the series of 1,260 cases, there were 18 patients who had acute abdominal conditions and were operated upon (Table II). It will be noted that although these patients had acute abdominal conditions, the fever and leukocytosis were not very marked and none had acidosis.

The abdominal symptoms in these patients were not nearly so severe as those seen under similar conditions in the nondiabetic. This decreased severity in abdominal symptoms in the diabetic has become more apparent the more cases we see. The number of cases is small; however, the behavior of the patients has been so similar that we feel justified in suggesting that an acute abdominal condition occurring in a diabetic will give symptoms which are much milder than those produced by a similar lesion in a nondiabetic and very much milder than those produced by acidosis alone. The appended case report exemplifies this.

TABLE II

EIGHTEEN CASES OF ACUTE ABDOMINAL CONDITIONS OCCURRING IN A SERIES OF 1,260 CONSECUTIVE PATIENTS ADMITTED BECAUSE OF DIABETES

Name	Age	Condition	Blood Sugar, Mg.	Plasma Carbon Dioxide	White Blood Cells	Fever
M. K.	64	Pyelonephritis	210	54	11,000	100°
W. H. S.	62	Gangrene of gallbladder	450	42	17,500	99.4°
A. O.	54	Ruptured appendix	280	43	14,200	102°
M. S.	42	Acute cholecystitis	242	50	15,200	100°
J. D. K.	52	Appendiceal abscess	303	54	13,000	99°
M. W. B.	47	Pyelonephritis	250	42	10,500	103°
E. T.	51	Acute cholecystitis	214	56	11,500	99°
R. S.	46	Empyema, gallbladder	195	58	13,500	101°
M. T. F.	49	Ruptured appendix	250	44	17,500	102°
P. T. W.	46	Pelvic abscess	243	42	16,250	103°
M. B. S.	59	Empyema, gallbladder	190	40	10,250	99°
R. S.	14	Acute appendicitis	204	49	10,750	99°
M. B.	15	Acute appendicitis	195	43	13,700	100°
J. S.	9	Ruptured appendix	330	44	13,500	102°
T. S.	43	Diverticulitis with abscess	190	54	11,200	100°
E. H.	41	Empyema of gallbladder	210	49	12,250	101°
A. B.	63	Gangrene of gallbladder	181	X	4,800	98°
A. W.	67	Empyema of gallbladder	196	X	26,800	100°

X—No acetonuria.

Case Report.—J. K., age 52, had been a diabetic for eight years. He developed a rather mild pain in the lower right quadrant of the abdomen and with it had very slight tenderness, no rigidity and a temperature not exceeding 99° F. The patient was observed for several days feeling that he might possibly have a mild case of epidemic gastro-enteritis. On the fourth day without any increase in symptoms a mass was felt in the lower right abdomen. He was admitted to the hospital with a temperature of 99° F.; a leukocytosis of 13,000; blood sugar, 303 mg.; plasma CO_2 54. He was operated upon and a large appendiceal abscess was found. Here in spite of a large amount of pus, no acidosis had developed and the symptoms were so mild that the extent of the lesion was not recognized.

Acidosis was not present in any of the 18 cases, although most of them had marked infections and even free pus in the peritoneal cavity which had been present for some time before admission. This is not the story of infection elsewhere in the body in the diabetic. Infection nullifies the action of a certain amount of the endogenous and exogenous insulin and usually makes the diabetes more severe and may even be the cause of precipitating acidosis.

In a series of 250 operations performed upon diabetics reported by the authors in 1933, we noted 24 cases that had acute infections within the abdominal cavity and in none of these was acidosis present. However, acidosis did develop in several other cases with relatively mild infections situated elsewhere in the body such as small carbuncles and minor infections of the extremities.

CONCLUSIONS

(1) Ninety-six or 74 per cent of 136 cases of diabetic acidosis presented the abdominal symptoms of nausea, vomiting and abdominal pain, which are associated usually with leukocytosis and fever.

(2) Acidosis should be ruled out in any diabetic presenting abdominal symptoms before surgical intervention is undertaken.

(3) Acute abdominal conditions occurring in diabetics do not seem to produce as severe abdominal symptoms as the underlying pathology would indicate or as developed in a nondiabetic under similar conditions.

(4) Surgery should not be undertaken with a CO_2 of less than 40 volumes per cent, and if the emergency will permit, the CO_2 should be elevated to 45 or 55 volumes per cent.

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Discussion.—Dr. F. A. Bothe in commentating on the tabulated statistics, referred to the last two cases listed in Table II; namely, the patients suffering from acute gangrenous cholecystitis and empyema of the gallbladder illustrate very definitely the experience we have had. These women were both admitted to the hospital with a history of having mild symptoms of seven to ten days' duration. The pain at no time was severe and upon abdominal examination mild tenderness accompanied by marked rigidity was found over the upper right quadrant. In both patients uranalysis revealed glycosuria and no acetonuria but a definite hyperglycemia was present. In the absence of acidosis in either case, operation was not delayed.

In contrast to these cases, he reported the case of a patient, age 43, who gave a history of having had excruciating abdominal pain and nausea and vomiting of three days' duration, accompanied by constipation. She was greatly dehydrated and the abdomen was markedly distended. The temperature was 103° F. and the leukocyte count 33,000. She was admitted to the hospital with the diagnosis of acute intestinal obstruction. Knowing that she was a diabetic, he immediately had an uranalysis, blood sugar, and CO_2 determination made. The urine was strongly positive for sugar, and the CO_2 was 17 volumes per cent, the blood sugar was 670 mg. per 100 cc. A diagnosis of diabetic acidosis was made which definitely contraindicated surgical intervention. Doctor Beardwood treated the patient for the diabetic acidosis and in 12 hours the abdominal symptoms had disappeared, and the patient progressed to an uneventful recovery. After the acidosis had been controlled there were no physical findings on abdominal examination which would point toward any intra-abdominal pathology. The contrast in the symptomatology and laboratory studies in the above cases is most instructive, and the more diabetics we see with abdominal conditions the more convinced we are that the symptoms in the diabetic are less severe than in the nondiabetic with intra-abdominal lesions under equal conditions, and that the most severe abdominal symptoms which we find in the diabetic occur in diabetic acidosis.

SARCOMA OF THE KIDNEY IN ADULTS

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Sarcoma of the kidney in adults is a rare lesion. Ninety-three such tumors form the basis of this communication. Nine were found among the records of the Massachusetts General Hospital, two from the private cases of Dr. George Gilbert Smith and the remainder from the literature.

Kilbane and Lester[31] recently collected 15 cases and added one of their own. Only seven of these are included in this report. Seven were omitted because they occurred previous to 1910. The eighth proved to be a calculous pyonephrosis. The large series of adult sarcomata reported by Judd[29] and the group of spindle cell sarcomata tabulated by Kretschmer and Randolph[32] are herein included. A complete survey of the literature on this subject has been made, and all questionable cases have been omitted. It was quite obvious that certain requirements should be definitely decided upon as to whether a case should or should not be included. Accordingly no case was accepted unless the microscopic report of the tissue examined was so worded that no doubt could be entertained that it fell into this group of kidney tumors. It was for this reason that this series started from 1910. It was not uncommon previous to that time to classify renal cancers as sarcomata. Only those cases of round cell sarcomata were acceptable where it was proven beyond a reasonable doubt (autopsy) that the renal lesion was not part of a generalized blood dyscrasia or an anaplastic carcinoma. It is true that in a number of instances this differentiation proved difficult. When this occurred the case was omitted.

It was equally necessary to omit neoplastic lesions originating in the surrounding mesothelial tissue which secondarily invaded the renal parenchyma. Unless the case history definitely stated that the sarcoma originated in the kidney substance, it was omitted. This naturally excluded the retroperitoneal tumors (sarcomata and lymphoblastomata), the neurogangliomata, the sarcomata of the renal capsule, the neuroblastomata and other adrenal tumors.

Although many articles have been written on adult sarcoma, yet no author seems to have drawn the line as to when a renal sarcoma may be called an adult renal sarcoma. With this in mind all cases of renal sarcoma under 21 years of age were excluded.

In many reported series of kidney tumors (Nichols and Shiflet,[38] Neff,[37] Mackenzie,[36] Fedoroff,[18] Phillips,[41] Hyman,[27, 28] and others) mention is made of a case or cases of adult renal sarcoma but no data are given on the particular patient. These likewise had to be omitted from this paper.

Age.—Age was not stated in 21 instances. Forty, or 55 per cent, oc-

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curred between 40 and 60 years. Twenty-three, or 33 per cent, were under 40, while only nine, or 12 per cent, were in the sixth and seventh decade (Table I).

TABLE I

AGE INCIDENCE

Age	Number	Percentage
21–30	8	
		33
31–40	15	
41–50	23	
		55
51–60	17	
61–70	5	
		12
71–80	4	
No mention	21	
Total	93	

Sex.—The sexes were equally divided, 46 in each. It was not noted in one instance (Table II).

TABLE II

SEX INCIDENCE

Sex	Number
Male	46
Female	46
Not noted	1
Total	93

Side.—Curiously enough both sides were affected the same number of times, 42 each. Bilateral involvement occurred once, and in eight cases the side of the lesion was not stated (Table III).

TABLE III

SIDE INVOLVED

Side	Number
Right	42
Left	42
Bilateral	1
Not noted	8
Total	93

Pathology.—The histopathology of these tumors is quite varied, and for all practical purposes, of little help. They all seem to be equally effective in producing the same end-result, that is death. The nomenclature is surely not without reproach. The most that can be said for it is that it confuses the

picture. Twenty different names are listed under which this adult sarcoma is masquerading. It is conceivable that if more microscopic sections were taken from different parts of the above listed tumors, many would be reclassified and called mixed tumors. It would be less confusing to call sarcomata, where two or more different types of cells predominate, mixed cell sarcomata, and reserve separate categories for sarcomata where only one type of cell predominates, such as fibro-, spindle cell, and leiomyosarcomata. A division of this sort would by no means be ideal but it would at least have the advantage of simplifying the confused nomenclature.

In this series there were 23 spindle cell sarcomata, 12 fibrosarcomata, 16 sarcomata, six leiomyosarcomata, four mixed cell, two Wilms' tumor, 11 embryonal mixed tumor, two embryonal myosarcomata, and one each of embryonal adenocarcinoma, embryonal adenosarcoma, lipoleiomyosarcoma, lipomyosarcoma, liposarcoma, fibromyxosarcoma, myosarcoma, rhabdomyosarcoma, reticular cell sarcoma, round cell sarcoma, teratoma, and osteoblastoma.

Bilateral sarcoma occurred once. As far as could be ascertained, these were distinct and separate tumors and not extensions. Two different types of tumor in the same kidney were noted five times: a fibrosarcoma together with an adrenal carcinoma, a fibrosarcoma associated with a papillary carcinoma, a leiomyosarcoma with an adrenal cell sarcoma, a spindle cell sarcoma with a squamous cell carcinoma of the renal pelvis, and an adenocarcinoma with a fibrosarcoma.

The association of stones with adult sarcoma occurred three times.

Scant data were obtained relative to metastases. The information gathered showed that this type of tumor differed little from adenocarcinoma or hypernephroma in the organs attacked. Invasion of the renal pedicle, extension to the diaphragm, metastases to the liver, lung and peritoneum were frequent in the cases that came to necropsy.

Symptomatology.—The symptomatology was not unlike that accompanying other types of adult cortical tumors. Tumor (mass) is not as predominant a symptom as in sarcoma in children. The triad of hematuria, tumor and pain are the chief complaints. Gastro-intestinal symptoms, such as nausea, vomiting, eructations, and constipation, appear to be slightly more frequent than in other forms of renal neoplasm. Varicocele occurred once as a chief complaint. Anemia, loss of weight, lassitude, and edema of legs were noted many times.

No statistics are available on the duration of the symptoms. Fortunately this knowledge would serve no purpose, as nearly all of the patients died regardless of the duration of symptoms.

As Table IV shows, 78 patients were submitted to a nephrectomy. An exploratory laparotomy was performed five times. Once a partial nephrectomy was performed (Berry[3, 4]) and the patient died after the operation. Five patients were considered inoperable and in three cases no mention of

the operative procedure was made. A loin incision was made once, but further information in this case is lacking.

TABLE IV

RÉSUMÉ OF OPERATIVE PROCEDURES EMPLOYED IN 93 CASES OF SARCOMA OF THE KIDNEY, AND THE END-RESULTS

Operation	No.	No Follow Up	Died		Recurrence		Living: Years	Living: Months	Less Than 1 Year
Nephrectomy (1 partial)	78	23	28 within 1 year	30	8 months	4	20 yrs.	12 mos.	12
			2 (8 years; 6 years)		1 yr. 7 mos.		2 yrs. 3 mos.	4 mos.	
					No time		6 yrs. 3 mos.	8 mos.	
					? recurrence (3 yrs.)		7 yrs.		
						21	1 yr. 3 mos.		
							2½ yrs.		
Exploration.....	5	3 All were inoperable	2 postoperatively						
No operation....	5		5						
Excision tumor..	1	1							
Loin incision....	1		1 one year postoperatively						
No mention of type of operation.....	3	1	2						
Total.....	93	28	40		4		21		

Of the 78 patients who had nephrectomies, there was no follow up in 23. Thirty died, 19 of these postoperatively. The causes usually given were shock and hemorrhage. It was quite obvious that a number of these patients had multiple metastases at the time of operation, and never should have had a nephrectomy. Nine others died within the first year, and two died after living six and eight years respectively. The former had four operations and died of recurrence, the latter of pulmonary tuberculosis.

Recurrence occurred four times: eight months, one year and seven months, and three years, and in one no time was stated. Twenty-one patients are living; fifteen less than one year. Six have passed the first year, three of whom have lived beyond the five year period. Of these latter three, one has lived 20 years, but the histologic diagnosis of sarcoma seems to be in doubt. One patient with a fibrosarcoma lived six years and three months, although an operative note stated that not all the tumor was removed. The third is apparently well after seven years. It is significant that in the 55 cases where a follow up was obtained only one patient (2 per cent) can be said to be cured.

Five patients were submitted to an exploratory laparotomy. Of these, two died postoperatively and at necropsy showed multiple metastases. Three were found inoperable. These patients were discharged from the hospital and no follow up was obtained.

In the group of five, where no operation was performed, all died and the necropsies revealed extension of the neoplastic process elsewhere. In the three cases where no mention was made of any operation, two died. There was no postoperative examination in the third. The patient who had a loin incision died a year following the operation.

Case Reports of Eleven Instances of Sarcoma of the Kidney Occurring in Adults

Case 1.—G. U. No. 301453. B. T. S. A white, married, native housewife, age 39, entered the Massachusetts General Hospital September 11, 1929, complaining of hematuria of two weeks' duration. The patient had been in perfect health until two months previously, when she noticed a dull ache in the right flank. This discomfort was not increased by movement or physical exertion. There was no radiation of the pain downward. With the exception of nocturia there were no other accompanying genito-urinary symptoms. Two weeks before entry to the hospital hematuria occurred for the first time. It was insidious, painless and total in character. Clots were often passed. Chills and fever were present. There was some stiffness of the right hip and leg, and pain along the entire right lower extremity. The hematuria persisted up to the time of admission to the hospital.

Physical Examination at this time revealed nothing abnormal above the diaphragm. There was marked tenderness in the right costovertebral angle and right flank but the kidney on that side was not palpable. There was spasm of the psoas muscle. Vaginal and rectal examinations were negative.

Cystoscopy showed a normal bladder. Both ureters were easily catheterized, and bilateral pyelograms were made.

Roentgenologic Examination.—The right kidney pelvis was incompletely filled and only the lower calix was visible. The left renal pelvis appeared normal. Findings on the right side were consistent with carcinoma of the kidney pelvis.

Roentgenograms of the chest, vertebrae, pelvis and upper extremities failed to show any evidence of metastasis.

Laboratory Data.—The blood nonprotein nitrogen was 26 mg. The Hinton test was negative. Intravenous phenosulphophthalein showed 50 per cent excretion in the first and 15 per cent in the second hour.

Operation.—September 28, 1928. Under ether anesthesia, the right kidney was exposed through a retroperitoneal incision, and found to be surrounded by thick adherent fat which was cleared away with some difficulty. There was a tumor mass situated at the upper pole of the kidney. The kidney was removed.

Pathologic Report.—Gross: A slightly enlarged kidney, 13 x 6.5 x 5 cm. in size and weight 260 Gm. There is a nodular mass situated at its upper pole. *Microscopic Examination* showed it to be a fibrosarcoma.

The patient made an uneventful convalescence and was discharged from the hospital 20 days postoperatively. Two months later the husband reported that the patient had died.

Case 2.—G. U. No. 298303. C. B. A white housewife, age 53, entered the Massachusetts General Hospital April 20, 1929, complaining of pain on the right side, loss of weight, and anorexia. Four months previously, the patient had begun to lose her appetite; she also vomited occasionally. She continued losing weight. Constipation was noted about four months ago, and she also noticed an increase in the pain in the abdomen, which seemed to be relieved somewhat by the passage of flatus. It was, however, at times very intense. Sometimes it would radiate across the entire abdomen and to the back. She had noticed a definite swelling of the abdomen. There were never any urinary symptoms such as frequency or nocturia.

Physical Examination showed a rather thin, emaciated female presenting a yellow skin and fine tremor of the hands. Heart and lungs apparently normal. Abdominal examination showed a marked protrusion of the right side, which proved to be a firm mass the size of a socker ball, which filled the entire right side of the abdomen. It did not appear to be connected with the liver, nor did it move with respiration. It extended to the brim of the pelvis, and was fairly movable. On percussion in the flank, the mass

seemed to be dull, but was tympanitic anteriorly. Pelvic and rectal examinations were essentially negative.

Roentgenologic Examination.—A barium enema showed a large mass in the right upper quadrant extrinsic to the colon, around which the colon looped. There was some deformity of the intestine, probably due to pressure, but no evidence of intrinsic disease of the colon itself.

Cystoscopy showed a normal bladder. Both ureteral catheters passed to each pelvis without obstruction.

A pyelogram of the right kidney pelvis showed it to be markedly distorted. It was apparently displaced upward and outward by a mass below it, which was interpreted as being consistent with tumor of the kidney. Left pyelogram was negative. Roentgenograms of the lungs, bones, and chest showed no evidence of any metastatic process.

Laboratory Data.—Red blood count 4,390,000; leukocytes 11,600; differential 70 per cent polynuclear cells, 7 per cent monocytes, with 23 per cent lymphocytes. Hemoglobin was 70 per cent. Icteric index 4. The blood nonprotein nitrogen was 30 mg. The renal function was 40 per cent in two hours.

Urine examination was essentially negative.

Operation.—May 1, 1929. A right nephrectomy was performed through a transperitoneal right-angle incision under spinal anesthesia and ether. A large kidney was found which was firmly adherent to the ascending colon. It was evident that in order to remove the kidney, the colon itself would have to be resected. It was, therefore, cut across below and above the kidney and a side-to-side anastomosis effected. The kidney was removed with the resected portion of the colon. The patient was given a transfusion of 500 cc. of whole blood.

Pathologic Report.—Gross: The specimen was a mass 24 x 12 x 11 cm. in size and weighing 720 gm. It consisted of a large irregular, firm nodular mass of whitish tissue surrounding the upper pole and anterior surface of a normal sized kidney. Attached to its upper anterior surface was a section of normal appearing colon 35 cm. in length. There were several firm, round, white nodules 1 to 2 cm. in diameter in the mesocolon. Section showed the upper pole of the kidney to be occupied by a spherical mass of fairly firm, yellowish-white tissue displacing but not invading the renal tissue. The tumor tissue above this was fairly firm, homogeneous and of a light yellowish color. In the portions more distant from the kidney the tumor was made up of a firm, homogeneous white tissue.

Microscopic Examination showed the presence of two different types of tumor: One was made up of large vacuolated cells arranged in solid masses and in places in long tubules and having the typical appearance of a renal adenocarcinoma. The other was composed of closely packed, poorly differentiated spindle shaped cells. Mitotic figures were numerous, and multinucleated forms common. The appearance was that of a very rapidly growing and highly malignant fibrosarcoma. In places the two types of tumor were intermingled. Several interpretations are possible: Two primary tumors, a mixed tumor, or a malignant degeneration of the stroma in a primary renal adenocarcinoma, the first being considered the most likely.

The patient did very well until eight days following the operation, when a fecal fistula developed. Intestinal obstruction occurred, and shortly afterwards the patient died of bronchopneumonia, probably terminal.

Autopsy (35573) showed a fecal fistula, sepsis in the operative wound, and metastases from the fibrosarcoma to the liver and peritoneum.

Case 3.—G. U. No. 261511. E. S. A white, English housewife, age 46, entered the Massachusetts General Hospital March 4, 1924, complaining of pain in the epigastrium and right hypochondrium of three weeks' duration. Three weeks previously the patient had been seized with a severe knife like epigastric pain radiating to the right hypochondrium and right back. It was accompanied by vomiting. This lasted for a few

days but gradually disappeared, leaving a "sore ache" in the right back. The pain was not related to the intake of food. There were no urinary symptoms.

Physical Examination showed a large, firm, slightly movable mass on the right side, extending downward to the right iliac crest. It was regular in outline and not tender. Pelvic and rectal examinations were negative.

Cystoscopy showed a normal appearing bladder. Both ureteral orifices were easily catheterized. A pyelogram of the right kidney pelvis showed the right kidney shadow to be normal in size, but rather peculiar in outline. Although the calices were made out and showed apparently the normal cupping, the appearance suggested that the peculiarity in the shape of the shadow of the pelvis was due to rotation rather than actual deformity. The outline of the left kidney showed it to be apparently normal in size and shape. The barium enema and Graham tests were negative.

Laboratory Data.—The blood nonprotein nitrogen was 50 mg. White blood count 9,200. Hemoglobin was 90 per cent. The urine contained 20 to 25 white blood cells.

Operation.—March 8, 1924. A renal tumor was removed through a transperitoneal right rectus incision.

Pathologic Report (3-24-24).—The kidney was covered with a thick, purplish-red tissue with a friable purplish-red mass (the size of a small orange) at the lower pole. On section it was largely composed of soft necrotic tissue and blood clot.

Microscopic Examination: Lipoleiomyosarcoma.

The patient was discharged 15 days postoperatively.

Case 4.—G. U. No. 286928. J. A. L. A native, white, married male, age 48, entered the Massachusetts General Hospital October 24, 1927, complaining of loss of weight, and intermittent attacks of pain in the right flank of 12 years' duration. Twelve years ago the patient experienced for the first time a sudden sharp severe pain in the right flank which awoke him from his sleep, and caused him to "double up." A roentgenologic report stated that he had stones in his kidney. There was a previous history of his having passed gravel at various times.

Present History.—For 12 years the patient had been asymptomatic. Six months ago he began to lose weight, and his appetite was markedly decreased. There was a history of a 60 pound weight loss in six months. Three days ago he complained of insidious hematuria with clots. Nocturia was present, diurnal frequency six to eight times. There was a history of attacks of renal colic dating back three months accompanied by very slight hematuria, and some intestinal symptoms.

Physical Examination showed a fairly well developed and well nourished man in no obvious discomfort. Blood pressure 110/65. There was some tenderness in the right costovertebral angle. A smooth, movable mass was palpable which did not move much on respiration. The mass extended down to within one inch of the iliac crest, and anteriorly over to the midline.

Cystoscopy showed a normal bladder. A thick swirl of pus was seen coming from the right ureteral orifice. A pyelogram of the right kidney pelvis showed an abnormality, in conjunction with a large calculus.

Laboratory Data.—The urine was infected. The blood nonprotein nitrogen was 30 mg.

Operation.—October 27, 1927. A right nephrectomy was performed under ether anesthesia. A preoperative diagnosis of calculus pyonephrosis had been made. The patient was discharged one month after operation, with a small draining sinus.

Pathologic Report.—Gross: A cystic and solid tumor the size of a child's head measuring 8.5 x 12 x 18 cm. It had the gross appearance of a pus kidney. On section the pelvis and calices were dilated with pus. There was a friable tumor mass the size of a billiard ball which projected from the surface of the pelvis, and a large branching stone was beside it. One pole was considerably larger than the other and on section it had an opaque grayish-white surface and formed a wall 2.5 cm. in thickness about

central dilated calices. The remaining third of the kidney was apparently not involved in tumor and the parenchyma formed a thin shell about the pus filled calices.

Microscopic Sections through the peripheral portion of the tumor showed large alveolar clusters of atypical, fairly well differentiated squamous cells with numerous cells in mitosis. The polypoid tumor in the pelvis had the structure of a spindle cell sarcoma. It was composed of pleomorphic cells, many of them elongated and spindle in shape and arranged in bundles. There were many huge multinucleated giant cells and many cells showed mitosis. The growth was disintegrated and filled with wandering cells and blood. It is probable that the two different forms of neoplasms had arisen from a malignant degeneration of a teratoma. Diagnosis: Squamous cell carcinoma. Spindle cell sarcoma. Pyonephrosis. Nephrolithiasis.

Case 5.—G. U. No. 285549. F. S. A white, foreign housewife, age 45, entered the Massachusetts General Hospital August 18, 1927, complaining of pain in the left back and lower left abdomen of six months' duration. For the past six months she had had intermittent attacks of dull pain in the left kidney region, radiating to the left lower quadrant. The pain came on two or three times weekly. Occasionally the pain was severe, but was never associated with any other urinary or gastro-intestinal symptoms. The pain became progressively worse and more frequent. Three days before entry to the hospital, the patient experienced a very severe pain in the left flank which seemed to radiate over the entire abdomen. There was some nausea but no vomiting. Frequency of urination occurred at this time. This attack lasted for a few hours and did not recur until the night before admission. A history of constipation was present, but no weight loss.

Physical Examination was negative except for a firm, rounded, smooth, rather tender mass in the left kidney region, about the size of a large orange. There was some costovertebral tenderness present on this side.

Cystoscopy showed a normal appearing bladder. A pyelogram of the left kidney pelvis showed a marked deformity present. There were some small areas of calcification present which looked like stones. Roentgenograms of the chest and bones were negative. Barium enema was also negative.

Operation.—August 22, 1927. A left nephrectomy was performed, the kidney being removed by morcellation. A hemorrhagic cyst was present. The patient was discharged October 19, 1927, and died October 28, 1927.

Pathologic Report (27-8-119).—The kidney weighing 350 Gm. and measuring 15 x 8 x 9 cm. The pelvis was tremendously dilated. Projecting into it was a necrotic tumor 8 cm. in diameter. At one pole of the kidney a small rim of kidney parenchyma was left.

Microscopic Examination showed a tumor composed of spindle cells, very rapidly growing, with many mitotic figures and numerous giant cells. There was little stroma. Many of the cells strongly suggested smooth muscle in appearance. Diagnosis: Leiomyosarcoma.

Case 6.—G. U. No. 230219. E. T. A white Italian clerk, age 37, entered the Massachusetts General Hospital May 9, 1919. There was a history of influenza of two years' duration. Four days ago the patient began to vomit without any apparent cause, and continued to do so all day. The vomiting lasted one and one-half days, when he noticed that his urine was red. There were no other genito-urinary symptoms, but slight nausea, without pain continued. The patient's bowels were always irregular. He developed a moderate frontal headache which lasted for two days, accompanied by dizziness and blurred vision. An abdominal mass had been recognized five months previously.

Physical Examination.—The patient appeared to be a well developed and well nourished male. Heart, neck, and lungs were all negative. There were no enlarged nodes anywhere. Abdominal examination revealed a fulness and distention on the right side. A mass filled the entire left upper quadrant and extended downward to the anterior superior spine on that side, and over to the midline. The mass was round, smooth, and not fixed. There was a marked varicocele in the left scrotal sac. The

patient's renal function was very low. The pyelogram was consistent with polycystic disease of both kidneys.

Laboratory Data.—The urine showed nothing abnormal except a slight trace of albumin. The sediment showed many red and white blood cells. The blood nonprotein nitrogen was 122 mg. Hemoglobin 55 per cent.

Operation.—May 10, 1919. An exploratory operation on the left kidney was performed under ether anesthesia. The diagnosis of polycystic disease of the kidney was made. Two days following operation, the patient became distended, and his respirations increased and became labored. This increased in severity, and the patient died five days after the operation.

Autopsy (No. 3951), May 13, 1919: Bilateral lipoleiomyosarcoma of the kidneys: Septicemia.

Case 7.—E. S. No. 207226. W. R. M. A white native painter, age 48, entered the Massachusetts General Hospital April 13, 1916, complaining of pain in the left upper quadrant. Two months ago he had the first attack of burning pain in the left upper quadrant, lasting all night. This was accompanied by nausea and vomiting. He did not notice anything peculiar in the urine. One month later he had a similar attack and passed quite a large amount of blood and clots in the urine. Since this time, he has had persistent hematuria, and marked frequency. During the last three weeks, he has had much nausea and vomiting. On two or three occasions, the vomitus contained blood. At the time of entry in the hospital the patient complained of severe upper quadrant pain which was worse at night. His abdomen had begun to swell, and he himself noticed a very large mass.

Physical Examination showed a fairly well nourished man. Heart and lungs were negative. There was no evidence of enlarged nodes. The abdomen was full, and the entire left side of the abdomen was occupied by a large, rounded, nodular, fixed mass which extended over to the right side. It was not tender, and did not move with respiration. The lower pole of the mass was on the crest of the ilium.

Barium enema showed no intrinsic disease of the colon.

Operation.—March 18, 1916. A left upper rectus incision was made which was connected at the lower end with another horizontal incision through the rectus muscle. A large cystic mass was found. The colon was adherent, but was easily freed. The mass was aspirated, and contained about two quarts of very dark fluid. The kidney was removed.

The patient did not cooperate, refusing to take any nourishment, and had to be tube fed. He died nine days after the operation.

Pathologic Report.—Gross: An irregular cystic tumor about the size of a child's head. The capsule contained more or less fat with a few nodules of new growth on the surface. Dissection showed multiple cysts which communicated by narrow connecting necks with each other and with the pelvis. The lining of the cavities was smooth except for a number of small pedunculated white to reddish-brown masses of firm fleshy consistency. Lying loose in the cavity were two rather large mulberry calculi. In the kidney substance there was a new growth, grayish to brownish-red on section.

Microscopic Examination showed a growth to be composed of masses of large cells with a little intercellular substance and with sinus like cavities without distinct walls. Diagnosis: Large mixed cell sarcoma.

Autopsy (No. 3573) showed sarcoma of the kidney with metastases to the lungs, pleura, and diaphragm.

Case 8.—W. S. No. 235884. E. A. F. A white native housewife, age 41, entered the Massachusetts General Hospital March 29, 1920, complaining of pain in the right groin and flank of one year's duration. The patient was perfectly well until one year ago when her pain began. At times it was rather severe but for the most part was more of a constant dull ache. Lying down seemed to aggravate the pain, while standing up

lessened it. About four months ago during an episode of pain the patient had a miscarriage. For the past two weeks the patient has been practically free from pain.

Physical Examination determined a hard, movable mass in the right upper quadrant. A pyelogram of the right kidney pelvis showed a moderate hydronephrosis. Both ureters were displaced to the right, but the displacement was more marked on the right side. A Graham test was made, and the gallbladder found to be negative. Barium enema was also negative.

Laboratory Data.—The urine showed an occasional white blood cell. White blood count 10,400. Hemoglobin 90 per cent.

Operation.—April 7, 1920. Through a transperitoneal incision a mass was found arising from the inner aspect of the upper pole of the right kidney which extended medially and downwards. It was adherent to the vena cava. The kidney was removed. Five small holes were torn in the vena cava which were tied with No. 0 chromic catgut. The patient was discharged April 26, 1920. On June 15, 1921, no evidence of recurrence was found.

Pathologic Report (20-4-29).—*Gross:* The kidney was 10 cm. long. A tumor weighing 628 Gm. was attached to the upper pole. On section the kidney showed no invasion of the parenchyma. The pelvis and calices were dilated. The tumor was intimately connected with the pelvis and compressed the ureter.

Microscopic Examination: Leiomyosarcoma.

Case 9.—H. O. No. 268850. V. A. A Greek machine cleaner, age 57, entered the Massachusetts General Hospital March 31, 1925, complaining of a "lump" in his right side. About four months ago, he said he first noticed a "lump" in the right upper quadrant, at that time the size of a nut. At first it was not tender, but was movable. The mass started growing rapidly until now it is the size of a grapefruit. It is tender at the present time, but still movable. For the past four months, there has been a weight loss of 15 pounds; in spite of this, the patient says he has a good appetite.

Physical Examination showed a thin, emaciated male, prematurely old, who showed evidence of weight loss. He appeared anemic. Both the inguinal and epitrochlear nodes on both sides were palpable. In the right upper quadrant, there was a firm, irregular, rounded mass, slightly tender and which felt like kidney. The mass moved with respiration. On entry, the patient passed about six ounces of bright red blood.

Cystoscopy demonstrated blood coming from the right ureteral opening.

Roentgenologic and Pyelographic Report (No. 115441).—May 3, 1925. Kidney outlines were not visible on either side. Films taken with radiopaque catheters in position showed an area extending from the tip of the twelfth rib downward across the psoas muscle to the spine and overlying the upper border of the ilium, in which there were dense irregular shadows. These shadows were more dense than bone and probably represented calcified masses. The pelvis of the right kidney occupied the center of the region just described. The pelvis was large with a smooth outline. Calices were also increased in size, particularly the upper. There was absence of the middle calix, and in none was the usual cupping present. The appearance was that of an hypernephroma.

May 4, 1925. In the posterior part of the right parietal bone there was an area of diminished density about 2 cm. in diameter which was quite round with sharply defined margins and in which the bone trabeculae were indistinct. No proliferative changes were present. This appearance was very suggestive of metastatic malignant disease. Other bones examined appeared normal. Chest was negative.

Laboratory Data.—Red blood count 3,830,000; white blood count, 15,700. The blood nonprotein nitrogen was 30 mg. Differential: 87 per cent polynuclear, 9 per cent lymphocytes, 4 per cent large mononuclear cells, no eosinophiles or basophiles, platelets diminished; red blood cells showed marked achromia, slight anisocytosis, and polychromatophilia. Hemoglobin 60 per cent.

Urine was red in color, and there was some frequency and urgency present. His son stated that at times he had noticed some clots in his urine. Hematuria was only of six months' duration.

Operation.—April 4, 1925. A right nephrectomy was performed through an eight-inch right rectus incision. No metastases were found in the liver. The posterior layer of the peritoneum was opened. A much enlarged kidney was removed and found to consist of a normal appearing kidney with a typical hypernephromatous growth on the anterior surface. A node about two inches long was felt on the anterior surface of the aorta and was removed. Another indurated area was felt in the region of the pedicle but was not disturbed. A rubber drain was inserted through the flank. The patient did remarkably well after the operation. Before discharge 18 days postoperatively, the wound was almost all healed. No follow up.

Pathologic Report (25-4-17).—*Gross:* A large, nodular tumor measuring 14.5 cm. in diameter. On section it filled all the renal substance except at one pole. Its surface was lobulated and largely necrotic with large areas of bony hardness in its center. Soft purplish-red lobules invaded the renal substance. The pelvis was dilated and contained a plug of soft tumor, about the size of an English walnut, adherent to its inner surface. A hard nodule, the size of a golf ball, was separate. It showed a white fibrous surface on section.

Microscopic Examination showed a mixed or teratomatous growth with both a sarcomatous and a carcinomatous arrangement. There were areas of large granular cells, which were often vacuolated and massed together between thin walled blood vessels, presenting a structure resembling the adrenal cortex. Other areas showed an adenomatous structure and contained small irregular gland tubules lined by rather large cuboidal epithelial cells, usually in a single layer with a lymphoid stroma between the tubules. The sarcomatous portions were composed of bundles of spindle cells, but the majority of the cells were pleomorphic with numerous giant cytoplasmic masses having multiple nuclei. About some of these pleomorphic cells, there were bands of hyaline like intercellular substance, which resembled osteoid tissue. Diagnosis: Embryonal mixed tumor with a regional metastasis.

Case 10.—B. M. No. 20648. A. D. A. A white native lady, age 56, entered the Baker Memorial Hospital October 20, 1935, complaining of a constant dull ache in the right loin of three months' duration. The present illness dates back one year, when the patient noticed that she was getting more and more tired doing less and less work. Nausea and vomiting came on intermittently, and later on, the patient noticed weight loss.

Physical Examination.—A mass could be palpated in the right upper quadrant. It was not tender, slightly fluctuant, and movable. The liver was enlarged.

Roentgenologic Examination demonstrated fluid in the right pleural cavity. There was some question of metastatic involvement in one of the lower right ribs.

Laboratory Data.—Red blood count, 4,240,000; white blood count, 210,500. Differential: 91 per cent polynuclear cells, 1 per cent large lymphocytes, 2 per cent small lymphocytes, 4 per cent monocytes, and 2 per cent eosinophiles. The hemoglobin was 70 per cent.

Operation.—October 26, 1935. An exploration of the right kidney was performed through an oblique kidney incision under ether anesthesia. The upper end of the incision passed through a swelling in the right back which had been noted before the operation. This proved to be a cavity lined with tumor tissue, and contained a thick oily fluid. The incision was then carried down and the kidney exposed. It was slightly larger than normal, and paler, with an irregular consistency and a hard woody feel. The ureter was cut and tied. The kidney was easily freed as the growth did not appear to have penetrated the capsule. The pedicle was not infiltrated. The pedicle was clamped and the kidney was removed. Some of the fatty capsule was removed. The right lateral border of the spine appeared to be rather prominent and irregular as if there had been metastasis to the tissue lateral to it. On palpating the chest wall from within the kidney wound, the tissues in the region of the metastasis felt nodular and thickened. It seemed as if the growth had passed between the ribs rather than originating in them. One cigarette wick was used. The wound was closed in layers.

TABLE V

RÉSUMÉ OF 93 CASE REPORTS OF SARCOMA OF THE KIDNEY OCCURRING IN ADULTS

Author	Sex	Side	Age	Symptoms	Pathologic Diagnosis	Operation	Follow Up
1. Cooke[10]	F	R	60	Mass right renal region	Malignant leiomyoma	Exploration	Died bronchopneumonia. Autopsy showed metastases to liver, peritoneum, and omentum. No urinary symptoms
2. Swan[48]	M	L	54	Pain and hematuria	Mixed cell sarcoma	Nephrectomy	Recurrence in lungs in 8 mos.
3. Swan	M	L	71	Hematuria	Leiomyosarcoma	Nephrectomy	Well after 12 mos.
4. Swan	M	L	55	Hematuria	Spindle cell sarcoma	Exploration Biopsy	Inoperable
5. Neff[37]	F	L	58	Tumor of left side. Gastro-intestinal symptoms	Wilms' tumor	Nephrectomy	No evidence of metastases. No follow up. Weighed 13.64 Mg.
6. Crosbie[11]	F	—	35	Pain lumbar region. Frequency of urination	Leiomyosarcoma	Nephrectomy	No follow up
7. Herman and Greene[24]	M	L	38	Soreness in abdomen. Gastro-intestinal symptoms. Cramps, vomiting, loss of weight	Sarcoma	No operation	Died Autopsy (restricted). Involvement of regional nodes. Extension to right kidney. Partial intestinal obstruction
8. Deuticke[15]	M	—	25	Pain kidney region. Mass	Sarcoma	Nephrectomy	Lived 20 yrs. ? of authenticity of record
9. Deuticke	F	—	39	Pain kidney region	Sarcoma	Nephrectomy	Died of recurrence after 6 yrs. Had 4 operations during that interval for recurrence
10. Grove[20]	M	R	24	Hematuria. Ache right lumbar region. Nocturia 2 mos.	Sarcoma	Nephrectomy	No follow up
11. Judd[29] (20 cases)	10 F 10 M	L (11) R (9)		Tumor (18) Pain (17) Hematuria (7)	Fibrosarcoma 6 cases Sarcoma 6 cases Round cell 1 case Mixed cell 1 case Myxosarcoma 1 case Liposarcoma 1 case Spindle cell 3 cases Fibromyxosarcoma 1 case	Nephrectomy 19 cases Biopsy and Exploration 1 case	Died postoperatively 3 cases Lived less than 1 yr. 12 cases Lived 8 yrs. and then died. ? tuberculosis 1 case Died during first year—pneumonia 1 case Living 2 yrs. and 3 mos. 1 case Living 4 mos. 1 case Living 6 yrs. and 3 mos. (This was a fibrosarcoma Grade 3. Did not remove all growth at operation) 1 case
30.							
31. Crutchfield[12]	F	L	27	Pea sized growth on each side of nose, cheeks and forehead. Pain left side	Wilms' tumor	No operation	Autopsy—tumor of left kidney adherent to left diaphragm and lumbar muscles
32. Kilbane[31]	M	L	48	Pain left flank. Hematuria	Embryonal adenomyosarcoma	Nephrectomy	Died 24 hrs. postoperatively
33. British Journal of Surgery[6]	M	L	35	Hematuria 4 da. Dull ache left side. Pain at tip of reins. Mass	Spindle cell	Nephrectomy	Well 7 yrs. postoperatively
Thatcher[49]	F	R	59	Severe pain right side. Occasional vomiting. Mass—1 yr.	Mixed tumor	Nephrectomy	No follow up. Osseous tissue found in center of tumor

35. Vermotten[51]	M	L	34	Hematuria. Pain left side. Mass Loss of weight—20 lbs. in 2 mos.	Spindle cell	Nephrectomy	No follow up. Weighed 2,700 Gm.
36. Thomas[50]	M	L	64	Burning, with no relation to food, about umbilicus—4 wks.	Round cell ? Mixed cell	Nephrectomy	Died 12 hrs. postoperatively. Hemorrhage
37. Kretschmer and	F	L	49	Hematuria, pain, tumor	Spindle cell	Nephrectomy	No follow up
and	F	—	46	Hematuria, tumor	Spindle cell	Nephrectomy	No follow up
Randolph[12]	M	L	59	Hematuria, pain, tumor	Spindle cell	Nephrectomy	Good recovery; origin in kidney pelvis
	F	R	24	Hematuria, pain, tumor	Spindle cell	Nephrectomy	Good recovery; origin in kidney pelvis
	M	L	55	Pain, tumor, varicocele, G. I. symptoms	Spindle cell	Nephrectomy	Recurrence in 1 yr., 7 mos.
	F	L	45	Pain, tumor	Spindle cell	Nephrectomy	Not stated
	M	L	54	Pain, tumor, edema	Spindle cell	Nephrectomy	Died some days after
	F	R	39	Pain, tumor, loss of weight	Spindle cell	Nephrectomy	Died few minutes after nephrectomy
	F	R	68	Tumor, loss of weight	Spindle cell	Nephrectomy	Died 11 da. after nephrectomy
46.	F	R	54	Pain, edema and varicocele	Spindle cell	Nephrectomy	Recovery
47. Hasner[22]	M	R	45	Pain right humerus region. Frequency. Polyuria. Hematuria — 1 mo. Mass. Varicocele—2 mos.	Mixed tumor	Nephrectomy	Metastasis to nodes along aorta. Died 1 yr. postoperatively
48. Holmes[26]	M	L	44	Fever, malaise, chilly sensations. Pus left kidney. Loss of weight. Mass. Colic at times	Spindle cell	Nephrectomy	No follow up
49. Pepper[40]	M	L	59	C.C., varicocele. Mass. Loss of appetite and weight. Anemia. Microscopic hematuria	Spindle cell	Laparotomy	Inoperable. No follow up
50. Ralphs[42]	F	R	39	Swelling right side	Spindle cell	Nephrectomy	Invasion of pedicle. Died few minutes after operation
51. Bruce[7]	M	R	50	Feeling of abdominal distension. Debility. Flatulence. Indigestion—1 yr. Mass. Weight loss—10 lbs.	Fibrosarcoma	Nephrectomy	Died 1 wk. postoperatively. Peritonitis
52. Davis[13]	F	—	60	Tumor. General malaise. Loss of appetite. Frequency—6 mos.	Teratoma (malignant)	Nephrectomy	Died 27 da. after operation. No necropsy
53. Oraison[39]	M	R	23	Loss of weight. Pain sacrohumerus region. Mass right side. No urinary symptoms	Sarcoma	Nephrectomy	Died 3 da. postoperatively. Marked anemia
54. Berry[3, 4]	F	R	43	Pain right flank. Hematuria	Fibrosarcoma. Adrenal carcinoma	Partial nephrectomy	Died postoperatively
55. Berry	F	L	35	Mass—left upper quadrant, Anemia. Splenic enlargement	Fibrosarcoma. Papillary carcinoma	Nephrectomy	Died 8 da. postoperatively
56. Berry	M	R	72	Loss of appetite. Mass	Leiomyosarcoma. Adrenal cell sarcoma	Nephrectomy	No follow up
57. Lutenbacher[24]	F	L	36	Loss of weight. Tumor of left side. Dyspnea. Cyanosis. Pulmonary symptoms	Fibrosarcoma	No operation	Necropsy showed tumor of left kidney
58. Hinman[25]	M	R	50	Pain lower abdomen. Mass right side. Hematuria—2 wks. Morning vomiting—5–6 yrs.	Sarcoma	Inoperable	Necropsy: metastasis to liver, pancreas, and abdominal nodes
59. Downes[16]	F	—	34	Asthma—10 yrs. Mass right side. Pain right lower abdomen—1 yr. Birth child 10 wks. ago. Lump noticed. Loss of weight	Embryonal adenocarcinoma	Nephrectomy	No follow up
60. Heppner[23]	F	L	71	Mass. Pain left side. No hematuria	Spindle cell sarcoma	Nephrectomy	Recurrence
61. Heppner	F	R	47		Sarcoma	Nephrectomy	

TABLE V (*Continued*)

Author	Sex	Side	Age	Symptoms	Pathologic Diagnosis	Operation	Follow Up
62. Heppner	F	—	26	Increasing mass—9 years' duration	Spindle cell sarcoma	Laparotomy	
63. Liebmann[33]	—	L	—	Tumor. Pain. No hematuria	Fibrosarcoma	Nephrectomy	Died
64. Baumann[2]	M	R	59	Hematuria	Embryonal mixed tumor	Nephrectomy	No follow up
65. Alleman and Bayer[1]	F	L	49	Mass. Necrotic tumor	Spindle cell sarcoma	Nephrectomy	No follow up
66. Roth and Schwoerer[44]	F	L	43	Pain. Tumor. Hematuria. Resection of thrombus	Spindle cell sarcoma	Nephrectomy	Died 3 da. later of uremia
67. Clay[9]	F	R	80	Pain. Mass. Urine negative	Embryonal myosarcoma	Nephrectomy	Good recovery
68.	F	R	39	Late hematuria. Mass	Fibrosarcoma	Nephrectomy	Died 2 mos. postoperatively
69.	F	R	53	Gastro-intestinal symptoms	Adenocarcinoma. Fibrosarcoma	Nephrectomy	Died 8 da. postoperatively
70.	F	R	46	Gastro-intestinal symptoms. Pain (colic)	Lipomyosarcoma	Nephrectomy	No follow up
71. Massachusetts General Hospital	M	R	48	Pain right flank—12 yrs. Loss of weight	Squamous cell. Stones. Spindle cell carcinoma	Nephrectomy	No follow up
72.	F	L	45	Pain. Gastro-intestinal symptoms	Leiomyosarcoma	Nephrectomy	Died 1 mo. postoperatively
73.	M	R & L	37	Gastro-intestinal symptoms. Mass	Bilateral sarcoma (lipoleiomyosarcoma)	Laparotomy	Died postoperatively
74.	M	L	48	Pain. Hematuria. Nausea. Vomiting	Mixed cell sarcoma. Calculi	Nephrectomy	Died 11 da. postoperatively
75.	F	R	41	Pain	Leiomyosarcoma	Nephrectomy	Well 1 yr. and 3 mos. postoperatively
76. Elmer and Boylan[17]	M	L	65	Mass left kidney region. Nausea, vomiting—2-3 months' duration. Loss of weight (15-20 lbs.). Constipation, anorexia	Reticular cell sarcoma (reticulocytoma)	Loin incision	Died 1 yr. postoperatively. Postmortem: metastasis to suprarenal lymphatics. Nodules in mesentery and lungs
77. Martin and Levrat[35]	M	R	50	Mass right hypochondrium	Rhabdomyosarcoma	No operation	Died. Autopsy: adrenal invaded. Retroperitoneal nodes around vena cava invaded. Metastases (multiple) to lungs
78. Watson and Russum[52]	M	R	45	Headache. Pain in lumbar region	Spindle cell sarcoma		Died
79. Saito[45]	M	R	26		Mixed tumor		
80. Smith	F	R	56	Dull constant ache. Right costovertebral pain of 3 months' duration. Fatigue—1 yr. Nausea, vomiting. Loss of weight	Fibrosarcoma (edema of leg)	Nephrectomy	Died 2 mos. postoperatively
81. Smirnowa-Zamkowa[46]	M	L	31	Hematuria. Piercing pain, left side—6 mos. Painless swelling, left side—5 mos.	Mixed tumor	Nephrectomy	Died 3 hrs. postoperatively
82. Rhode, C.[43]	M	R	52	Pain, right kidney region. Slight pain, left kidney region—1 yr.	Mixed tumor	Nephrectomy	Died, coma, 1 mo. postoperatively
83. Desnos[14]	M	L	48	Pain, left side—2-5 yrs. Intermittent hematuria—9 yrs.	Mixed tumor	Nephrectomy	Died 9 mos. postoperatively. Metastases and recurrence
84. Brugnatelli[8]	F	R	43	Painless swelling, right side—5 mos. Evening fever	Mixed tumor	Nephrectomy	No follow up
85. Ssoroko[47]	F	R	58	Severe pain, right abdominal and lumbar region—2-3 wks. Movable tumor—17 yrs. Obstipation	Mixed tumor	Removal of tumor from kidney	Discharged 20 da. after operation, feeling fine

86. Ssoroko	F	L	34	Severe pain, left lumbar region. Palpable tumor—13 yrs.	Mixed tumor	Nephrectomy	Well 8 mos. postoperatively. Able to work
87. Brandt[5]	M	L	68	No mention	Myosarcoma	No mention	Metastases to lungs and liver
88. Brandt	M	L	37	Severe pain in iliac region 2 da. before admission	Mixed tumor	Nephrectomy	No follow up
89. Smith	F	R	67	Gastro-intestinal symptoms—3½ yrs. Mass	Fibrosarcoma	Nephrectomy	Well 2½ yrs. postoperatively
90. Keefe[20]	F	R	44	Pain, back and right loin	Embryonal sarcoma	Nephrectomy	Well 3 yrs., then had symptoms
91. Geschickter—Widenhorn[19]	M	R	40	Pain, liver region. Distention in right upper quadrant	Sarcoma	Nephrectomy	Died
92. Massachusetts General Hospital	M	R	57	Hematuria. Lump right side	Embryonal sarcoma	Nephrectomy	No follow up
93. Haining and Poole[21]	M	L	76	Frequency, nocturia, dysuria. No hematuria	Osteoblastoma	Nephrectomy	Died. Necropsy: involvement of other kidney, liver, mesentery, bowel. Peritonitis

Following operation, the patient developed edema of both legs. The edema was thought to be nutritional, for the patient did not eat after the operation, and her appetite was very poor before the operation. The wound finally healed after a moderate degree of sepsis, and the patient was discharged November 27, 1935. She died one month later.

Pathologic Report.—Gross: A kidney measuring 11 x 6 x 5 cm. in size with the capsule attached. The specimen had been previously sectioned and the capsule removed, exposing a smooth pale cortical surface. The lower two-thirds of the organ were rounded and of soft consistency. The pelvis and first portion of the ureter for approximately 3 cm. were filled with soft yellow finely granular tumor tissue, a direct extension of the neoplasm from the renal parenchyma. Only the upper pole of the kidney appeared relatively uninvolved in the neoplastic process, which showed numerous areas of finely granular yellow neoplastic tissue embedded in a pale white fibrous stroma. The renal vein could not be identified in the specimen. Diagnosis: Fibrosarcoma.

Case 11.—B. B. A Russian-born housewife, age 67, entered the hospital June 12, 1933, complaining of kidney and intestinal trouble of three and one-half years' duration. She had apparently been well until about four years ago, when she noticed that her appetite had increased noticeably, and yet, she did not feel up to par. About this time she had intractable itching around the vulva, lasting about three months. Three and one-half years ago, she was thought to have had diabetes. She had lost about 20 pounds in weight. She has been constipated all her life. About three years ago the constipation became so intractable that no form of laxative would move her bowels. Associated with the onset of this obstipation was a sharp pain in the right hypochondriac region. Symptoms referable to the genito-urinary system have been so numerous the past year and a half that the patient does not really know what she has had, although she claims that she has had nocturia four or five times a night, frequency, occasional hematuria, dysuria, and incontinence. The urine has ranged from red to thick, smoky color.

Intravenous Pyelogram (6/14/33) showed a normal left kidney and a partially filled right pelvis.

Diagnosis: Right renal tumor; possible involvement of bowel.

Operation.—June 26, 1933. A right nephrectomy and appendicectomy were performed under avertin and gas-oxygen anesthesia. The right rectus incision was carried outwards for two inches at the lower end. The peritoneum was opened, and the tumor found to be pushing the posterior peritoneum forwards to the outer side of the ascending colon. The liver was smooth. The gallbladder was soft. No masses were felt suggesting extension of disease. The posterior peritoneum was incised over the kidney. The kidney was freed, the ureter cut and the pedicle tied with No. 3 catgut. The kidney was then removed and the pedicle again tied. Some extrarenal fat was removed. One cigarette wick was passed between the peritoneum and the abdominal wall into the renal fossa. The posterior peritoneum was then closed. The appendix, which was free and rather scarred, was removed and the stump buried. The peritoneum was closed without drainage. The abdominal wall was closed in layers. Convalescence was fairly smooth. When she was seen two years later, no evidence of recurrence was found.

Pathologic Report (6-26-33).—Mixed tumor of the kidney, highly malignant. Healed appendicitis.

CONCLUSIONS

There is only one conclusion that can be drawn incontestably from this survey, namely, that adult renal sarcoma is just as lethal a tumor as embryonal carcinoma in children. End-results are available in 65 of 93 cases. Twenty-one are living, and only three have gone beyond five years. Of the three living who passed the five year period, there is some doubt about the

history of one, and very little chance for cure in another, as the record stated that not all of the tumor was removed during nephrectomy. The third patient is well after seven years.

It appears that regardless of the type of sarcoma, death usually intervenes.

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PYOUMBILICUS ASSOCIATED WITH UMBILICAL CONCRETIONS

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Pyogenic infections of the umbilicus seldom occur in adult life and when encountered present several very interesting problems. In the first place, there are usually coexisting anatomic defects which act as precursors to these infections; secondly, they are usually associated with the formation of umbilical concretions; thirdly, these inflammatory reactions are prone to become chronic as they have a pernicious tendency to recur; and, lastly, they eventually terminate in serious complications. An appreciation of these facts can best be emphasized by actual case presentations.

Peritonitis Following the Spontaneous Rupture of an Umbilical Abscess with the Escape of Pus and the Extruded Umbilical Concretion into the Abdominal Cavity

Case 1.—A physician, age 26, entered the hospital because of a "painful umbilicus." Seven years ago he first experienced a deep seated muscular pain in the umbilical region. A few days later, a firm inflammatory intumescence appeared at the "navel" and slowly spread toward the bladder. He suffered from a pronounced urgency and frequency of urination but repeated uranalyses failed to show any pyuria. Seven days later a thin rancid discharge escaped from the umbilical crevice and all symptoms slowly subsided. Since then he has been conscious of a "soreness in the periumbilical tissues." Pressure of his belt, forced expirations, or the act of defecation usually provoked sharp twinges of umbilical pain.

Ten days ago he complained of generalized abdominal cramps which seemed to originate at the umbilicus. A hard, firm, tender mass appeared in the subumbilical region. The slightest pressure on this tumor elicited severe pains. He was unable to endure the irritation of his clothing, and the act of walking, coughing and sneezing became unbearable. When recumbent, his thighs were flexed on his abdomen in order to lessen the tension of the recti muscles. Three days later the umbilicus suddenly became swollen, red and hyperemic. A few drops of white creamy pus escaped from the umbilical groove, smears and cultures of which revealed the presence of a mixed streptococcic and staphylococcic infection.

Hot fomentations, antiseptic irrigations and repeated dilations of the umbilical orifice were all ineffective. The inflammatory induration spread downwards toward the bladder causing a marked dysuria, but again neither pus nor bacteria could be demonstrated in the urine. As the pyogenic process followed the round ligament up toward the liver, he developed paroxysms of nausea and vomiting. His temperature rose to 101.8° F. and his leukocytes increased to 18,600. All the muscles of the anterior abdominal wall were so tender and spastic that no intra-abdominal tumor could be felt.

Failure to respond to conservative treatment caused considerable alarm for it indicated the presence of some coexisting complication. The extension of the suppurative process toward the bladder and the presence of a dysuria suggested the possibility of an infected urachal cyst or a patent urachus. Hoping, therefore, to visualize the cyst, 10 cc.

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of lipoiodine were injected into the umbilical crevice. The contrast medium followed along the umbilical groove, penetrated the linea alba and entered a large "intra-abdominal pocket." This cystic cavity extended downward to within 3 cm. of the bladder, but none of the opaque medium entered this viscus. Aniline dyes which were introduced into the umbilical sinus did not appear in the urine, hence disproving the presence of a patent urachus. Thinking that this was a urachal cyst which might rupture spontaneously, an exploratory laparotomy was advised.

Under ether anesthesia, the abdomen was opened by a left rectus incision in order to examine the peritoneal surface of the umbilicus without disturbing the cyst. A large fluctuant tumor mass was found attached to the peritoneum of the anterior abdominal

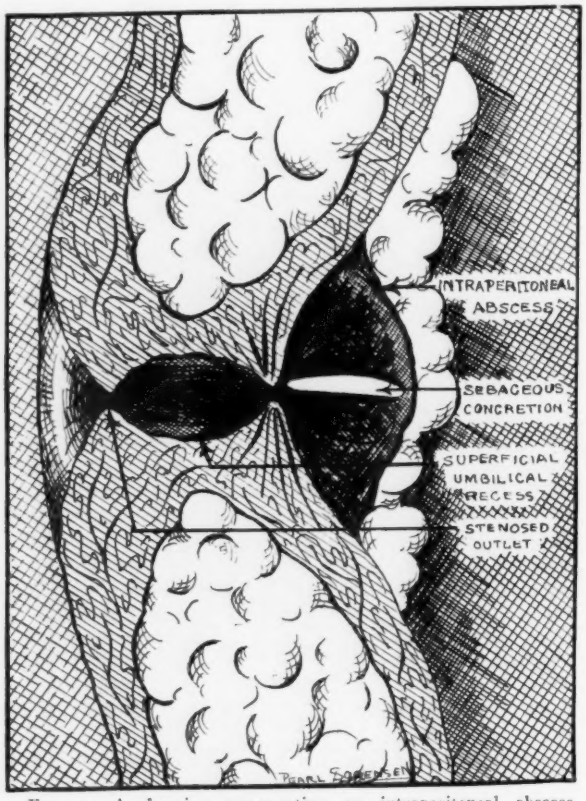

FIG. 1.—A drawing representing an intraperitoneal abscess formed by the spontaneous rupture of an umbilical abscess with extrusion of a sebaceous concretion into the peritoneal cavity.

wall. It extended from the umbilicus to within 3 cm. of the dome of the bladder and upward along the falciform ligament to the lower border of the liver. This hyperemic, inflammatory but cystic tumor measured two and one-half inches in diameter and five inches in length. Careful examination revealed that this was not a true urachal cyst but rather an intra-abdominal abscess which had become walled off by the thick edematous omentum. Realizing that the infection originated in the umbilicus and involved the anterior abdominal wall, it seemed advisable to excise all the diseased tissue. This was accomplished without rupturing the abscess but necessitated the removal of a large segment of the abdominal wall. In spite of all these precautions he developed a generalized peritonitis which resulted in a stormy convalescence from which he made an eventual recovery.

Pathologic Examination.—The specimen consisted of the umbilicus and the surrounding segment of the anterior abdominal wall. The umbilical cushion was so swollen, indurated and edematous that it practically occluded the external orifice of the umbilicus (Fig. 1). Extending from the stenosed cutaneous opening to the linea alba was a slightly dilated umbilical tract which formed a definite loculated recess lined with ulcerated epithelial tissue. Coursing along the side of the cicatrized remnants of the umbilical cord was a small patulous fistula which connected the superficial umbilical recess with a large subumbilical intraperitoneal abscess. The latter measured two and one-half inches in diameter and four inches in length and was formed by the peritoneum anteriorly and by the omentum in all other directions. Slight pressure on the intra-abdominal abscess caused thick, foul smelling pus, loaded with flaky desquamated material, to escape from the cutaneous umbilical opening. On incising this loculated abscess, it was found to contain three ounces of pus in which a yellowish white, cigarette shaped, glistening object was floating. This foreign body was 1.5 cm. long and .5 cm. in diameter and had the consistency of soft paraffin. It was somewhat compressible and was composed of an homogenous cheesy matrix containing exfoliated epithelial cells, small fragments of cotton threads, and few short strands of hair. Gentle pressure on the large abscess caused this concretion to pass through the small fistulous tract into the superficial umbilical recess. Extending downward from the umbilicus toward the bladder was a firm, inflammatory intumescence which was confined to the properitoneal space, thus being extraperitoneal. Repeated gross and microscopic examinations failed to show any evidence of an urachal cyst or a vestige of the urachus but merely indicated an acute inflammatory reaction of the properitoneal fat. A similar inflammatory process followed the round ligament up toward the liver, this, too, being extraperitoneal. The restraining abscess wall consisted of omentum and was not lined with either endothelial or epithelial tissues.

The probable sequence of events is as follows: The cicatricial stenosis of the external umbilical orifice caused a retention of sebum and desquamated epithelial cells. These products, combined with small fibers of cloth from the clothing and a few strands of hair, formed an inspissated concretion which irritated the epithelial lining of the umbilical tract, thus resulting in ulceration, infection and abscess formation. Being unable to escape, the accumulated pus dissected its way along the umbilical cord until it finally ruptured into the peritoneal cavity, thus permitting both the pus and the concretion to escape into the abdomen. The alert omentum prevented a generalized peritonitis from occurring by localizing the infection. Simultaneously the inflammatory process invaded the properitoneal space, first following the obliterated hypogastric vessels and the fibrous urachus downward toward the bladder and likewise dissecting its way along the falciform ligament toward the liver. Our inability to demonstrate a patent urachus or to find any histologic evidence of a cyst wall, combined with the fact that the falciform ligament was involved in the same inflammatory process, negates the probability of this being an infected urachal cyst. Apparently the sebaceous plug had penetrated the anterior abdominal wall and was responsible for this unusual catastrophe.

In a rather careful search of the literature we were unable to find a similar instance of an umbilical concretion spontaneously perforating the linea alba and forming an intra-abdominal abscess. The nearest analogy to this was

the cases of ruptured urachal cyst and pyourachus reported by Lazarus and Rosenthal[18] and by Deneen and Margold.[9] In these cases they experienced no difficulty in demonstrating the presence of a patent urachus.

Recurring Umbilical Cholesteatoma Associated with a Pyoumbilicus

Case 2.—Miss A. N., school teacher, age 24, entered the hospital complaining of a "painful navel." When six months old, her umbilicus became red, swollen and tender, and emitted a foul, rancid discharge for a period of three weeks. Since then she has had five similar attacks, the most severe one occurring five years ago, when she complained of epigastric distress, periumbilical pain, and pronounced abdominal tenderness. A thick, creamy pus escaped from an irritated and inflamed umbilical crater. Gentle dilatation of the external orifice, combined with antiseptic irrigations, caused the inflammation to subside and permitted the spontaneous extrusion of a small "bean-shaped" object. It was covered with a white glistening "membrane" and was composed of a thick, cheesy, sebaceous material containing a central plug of hair. Her Parisian physicians thought it to be an expelled sebaceous cyst. All signs of inflammation immediately subsided.

There were no exacerbations until three days ago when she felt a sharp twinge of periomphalic pain. Walking, riding, sneezing, coughing or localized pressure increased the discomfort. Two days later, a thin, purulent, malodorous discharge escaped from the umbilical depression and caused an excoriation of the surrounding skin. Anorexia, nausea and malaise were concomitant.

Examination revealed an angry, red umbilicus emitting a thin streptococcal laden pus. The umbilical cushion was so swollen and edematous that it practically occluded the umbilical orifice. Attempts to pass a small probe elicited severe pain. The inflammatory process had spread to the periumbilical tissues for a radius of 3 cm., forming a hard, indurated, tender tumor of the anterior abdominal wall. No suprapubic tenderness could be demonstrated. The urine did not contain pus and dyes injected into the sinus tract did not discolor the urine. Roentgenographic visualizations of the umbilicus following the introduction of lipoiodine demonstrated that the umbilical groove was definitely dilated but that it was not patent beyond the linea alba, being obliterated by the umbilical cicatrix. No evidence of a patent urachus or intra-abdominal abscess was seen but a negative shadow indicated the presence of a retained concretion.

Following the application of hot packs to the umbilicus, two ounces of thick pus escaped. Then the cutaneous stoma was gently dilated and a firm, white ovoid body was expressed. This mass measured 3/4 cm. in diameter and 2 cm. in length and was covered by a shining pseudomembrane which proved to be nothing more than inspissated sebum. The central core consisted of three strands of hair and two small fibers of cloth which were imbedded in a homogenous matrix of rancid sebum. Ten days later, after all signs of infection had subsided, the umbilicus was excised in order to prevent a recurrent omphalitis.

The specimen consisted of a dilated umbilical pouch, having a diameter of 2 cm. and a depth of 5 cm. The external stoma was very small, being practically occluded by the hypertrophied umbilical cushion, and the inner end terminated blindly in the cicatrix just before the cord penetrated the linea alba. The epithelial covering of the cavity was ulcerated and studded with multiple abscesses. Microscopically, the tissues merely evidenced an acute inflammatory reaction and no signs of a patent urachus could be found.

The interesting phase of this case was the pernicious tendency for omphalitis to recur and the formation of two distinct sebaceous plugs, both of which were extruded spontaneously. Apparently the anatomic conformation of the umbilicus was such that the narrowed cutaneous stoma favored the accumulation of sebum and desquamated epithelial cells resulting in the formation of

sebaceous cholesteatomata. Emphasis should be placed on the futility of treating these recurring pyogenic infections of the umbilicus without attempting to correct the predisposing anatomic factor. Had the umbilicus been removed following the extrusion of the first concretion, or if the external ostium had been kept widely dilated, the subsequent infections would not have occurred.

Concretion Associated with Pyogenic Granuloma of the Umbilicus

Case 3.—Mr. R. C., age 42, came to the dispensary complaining of a "boil in the belly button." Four years ago he developed a frank hematuria. Cystoscopic examination revealed two pedunculated papillomata arising from the dome of the bladder. They were removed by transurethral fulguration and histologic studies demonstrated the

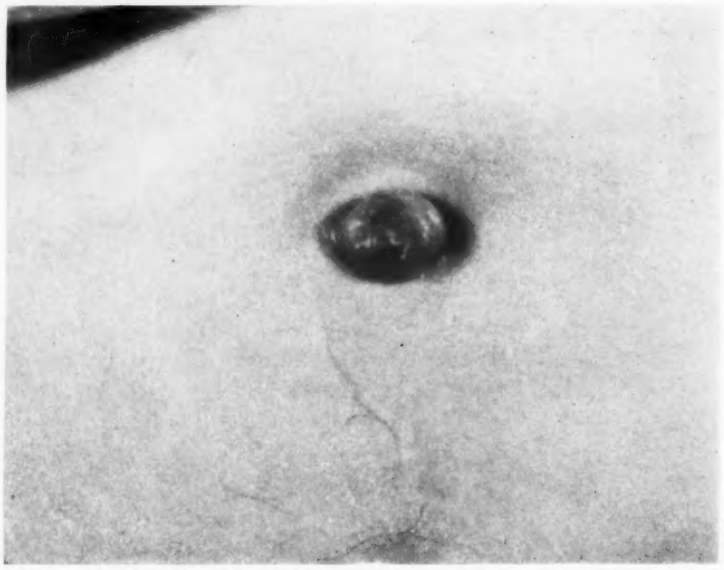

Fig. 2.—Pyogenic granuloma of the umbilicus, secondary to a retained umbilical concretion.

presence of an adenopapillary carcinoma. He was then given a course of intensive roentgen therapy. All symptoms disappeared until two years later, at which time he again complained of a dysuria associated with a hematuria. Examinations showed that the entire dome of the bladder was involved in an infiltrating, papillomatous type of tumor. This neoplastic segment of the bladder was resected and complemental roentgen therapy was given. He made excellent progress until three months ago at which time he again voided some bright red blood. Thinking that his problem was hopeless he neglected to return to the hospital.

Ten days ago he first experienced a rather sharp, persistent pain about the umbilicus and on examining himself he found a hard, indurated periumbilical swelling. This tumor mass rapidly increased in size and as it protruded from the umbilical crater it resembled a large boil. Three days later the "boil" ruptured and thick, malodorous discharge escaped. This afforded partial relief but the persistent soreness and pain continued. He was nauseated and experienced alternating sensations of "fever and chills." The hematuria became very pronounced but no trace of blood or urine could be detected in the umbilical secretion. Gram-positive Diplococci and Staphylococcus aureus were grown from the extruded pus.

On examination, the periumbilical structures were found to be hyperemic, swollen and indurated. The tissues in the suprapubic area were sensitive to the slightest touch and moderate pressure elicited intense pain. No suprapubic tumor could be defined and while manipulation of these inflamed tissues gave the patient an intense desire to void, it did not increase the discharge from the umbilical fistula. Arising from the upper half of the umbilical cushion was a walnut sized tumor having a deep red color. It was exquisitely tender and seemed to completely block the cutaneous outlet of the umbilical crevice (Fig. 2). Attempts to pass a fine wire probe through the stenosed opening elicited severe pain but resulted in the evacuation of a few drops of thick pus. Cystoscopic examination demonstrated two large papillomatous recurrences with marked infiltration and roughening of the entire upper three-fourths of the bladder. This malignant lesion encroached on the ureteral orifices in such a manner as to render excision impos-

FIG. 3.—Roentgenographic visualization of the offending umbilical concretion by injection of 1½ cc. of thorotrast into the umbilical crevice.

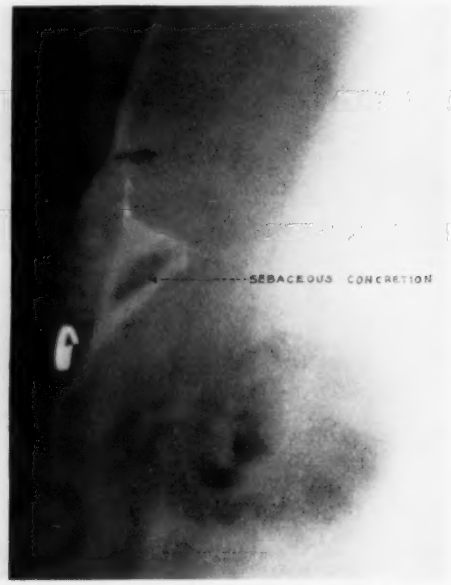

FIG. 4.—Two cubic centimeters of thorotrast outline the dilated superficial recess and demonstrate the sebaceous concretion.

sible. No evidence of a urachus could be seen and dyes which were injected into the umbilical sinus did not discolor the urine.

Hot fomentations and antiseptic irrigations facilitated the drainage of the periomphalic abscess but it did not cause a decrease in the size of the umbilical tumor. Because of its refractory nature it was thought that this neoplasm might be a carcinomatous transplant from the bladder, the malignant cells having traversed a patent urachus. Therefore, a biopsy was advised. After anesthetizing the umbilicus it was forcibly dilated and a half ounce of pus and desquamated material was expressed. Thereupon, 5 cc. of lipoiodine were introduced into the umbilical sinus. A roentgenogram demonstrated that the contrast medium had completely filled the dilated superficial umbilical recess. This "dilated pouch" extended from the skin to the linea alba and measured 2.5 cm. by 5 cm. No evidence of a patent urachus or a urachal cyst could be found. In the center of the dilated umbilical tract was a "negative shadow" which indicated that some solid substance had replaced the thorotrast (Fig. 3). On introducing a hemostat into the superficial umbilical recess, a definite obstruction was encountered and on attempting to remove this "impediment," eight fragments of a sour rancid sebaceous plug were extracted. A portion of the tumor was then excised. Histologic studies of this tissue

demonstrated a simple pyogenic infection of the umbilical tract without evidence of malignant changes. The inflammatory reaction immediately subsided and the patient left the hospital as he refused treatment for the bladder neoplasm.

Chronic Pyoumbilicus Which Had Drained for a Period of 21 Years Due to Retained Concretions

Case 4.—Mrs. L. L., housewife, age 50, was admitted to the hospital because of heart trouble, diabetes and an "infected navel." Since the birth of her first child, 21 years ago, she has had a persistent drainage from the umbilicus. At times the circumumbilical tissues would become sore, swollen, tender and painful. Then a rather thick offensive fluid seeped from the umbilical groove. The escape of this material was always followed by a cessation of the pain and discomfort. At times the purulent discharge became so repulsive that she resorted to frequent irrigations in order to overcome the unpleasant odor. Two weeks ago the umbilicus became very painful, tender and was extremely sensitive to pressure. Three days later a foul malodorous discharge escaped from the umbilical crevice and since then there has been a persistent drainage.

Examination demonstrated a funnel shaped umbilicus having a firm, indurated, protruding umbilical cushion. The stoma was so narrow that it would not admit a small wire probe, and any attempt to dilate the orifice caused pain. Pressure on the periumbilical tissues expressed some thick, rancid pus which contained numerous Staphylococci. There was no tenderness over the liver or urachal areas.

Conservative treatment in the form of hot moist packs and antiseptic irrigations caused much of the induration to subside. Thorotrast was then injected into the umbilical sinus. The contrast medium formed a V shaped outline signifying the presence of a superficial dilated umbilical tract. The central part of the tract gave a suggestive negative shadow indicating the presence of a foreign body (Fig. 4). The region was anesthetized and the orifice was dilated. A bean shaped plug of sebum was expressed from the umbilicus, following which some flaky foul smelling pus escaped. Continued irrigations and fomentations resulted in a rapid subsidence of the inflammatory reaction. Two weeks later the superficial umbilical tract was excised and was found to extend down to the sheath of the linea alba. It consisted of a dilated pouch measuring 2 cm. in width and 4 cm. in depth. Its epithelial lining was ulcerated and inflamed and there were considerable fibrosis and lymphocytic infiltration of its walls. No evidence of a sebaceous cyst, patent urachus or persistent omphalomesenteric duct could be found. The wound healed by primary intention.

Discussion.—Interestingly, each of these four cases was associated with umbilical concretions which were directly responsible for the omphalitis. Careful examination of the excised specimens indicates that there was one characteristic anatomic defect which was responsible for the formation of these concretions, namely, a stenosis or narrowing of the cutaneous umbilical orifice. When it is remembered that the umbilical tract is lined with epithelial tissue it becomes apparent that there is a constant production of sebaceous secretions, and desquamation of hair and epithelial cells. Normally, these products pass out through the gaping umbilical orifice but if the cutaneous ostium is obstructed, then these substances accumulate and form a concretion. In these cases the obstruction was caused by a fibrotic stenosis of the cutaneous ring. The external umbilical stomata were so narrowed that they would barely admit a small wire probe. Occasionally a tumor such as a fibroma,[4] myxoma,[22] dermoid cyst,[17] or pyogenic granuloma may occlude the umbilical groove. As the concretion becomes larger, it begins to irritate the

epithelial lining, resulting in a pressure necrosis, infection and finally abscess formation.

The majority of concretions are composed of an homogenous sebaceous matrix which contains desquamated epithelial cells, strands of hair[24] and a few fibers of cloth. However, other extraneous material such as dirt,[14] coal,[14] stone, chalk,[19, 14] hair balls,[24] flannel fibers from a belt,[28] wild oat straws,[10] and maggots[12] have formed the central nidus of such concretions. As the sebaceous plug grows it also becomes dehydrated for the moisture is absorbed by the adjacent tissues. Thus the inspissated sebaceous body may form a hard, cornified plug which may protrude from the umbilicus or it may become so hard and pearly like that it resembles a cholesteatoma. To these latter Coenen[6] has applied the term "umbilical cholesteatoma" because of their close similarity to the aural cholesteatoma.

Uncleanliness in the care of the umbilicus is often given as predisposing toward the formation of concretions. This is not absolutely true, as each of our patients had excellent habits of personal hygiene and had paid particular attention to the cleansing of the umbilicus. Hence, the collection of the sebum was not due to faulty care, but due to the fact that the stenosed cutaneous opening was so small that they could not properly remove the accumulated cellular detritus.

The preoperative diagnosis of a pyoumbilicus secondary to retained concretions is seldom made. This is due to the fact that suppurative omphalitis is so frequently associated with other causes. The failure to recognize an incarcerated sebaceous plug or cholesteatoma occasionally accounts for some cases of recurrent periomphalitis. At the time of examination, the umbilical tissues are so sore and tender that one cannot feel the concretion, and the ostium is so small that the plug of sebum cannot be felt with an instrument. Hence the only manner of recognizing these concretions is to resort to roentgenographic visualization. The use of such substances as lipoiodine and thorotrast clearly depicts the location and size of the foreign bodies and thus facilitates their removal. Likewise, these roentgenograms visualize associated complications such as an intra-abdominal abscess, a coexisting patent urachus, a urachal cyst, or a subumbilical abscess. We did not surmise the presence of the intra-abdominal abscess in the first case until the visualization studies were made.

Omphalitis with or without associated discharge presents a very difficult diagnostic problem, as it is usually secondary to other pathologic changes. When it is remembered that the umbilicus is the thinnest part of the abdominal wall, one appreciates why so many suppurative lesions choose this exit for their drainage course. The literature contains numerous examples in which an umbilical fistula may result from the spontaneous rupture of a periprostatic,[23] pelvic,[11] appendiceal[13] or liver abscesses[3]; or it may be associated with a pneumococcic,[5] tuberculous[2] or other form of pyogenic peritonitis.[27] The contents of a patent[15] or malignant[7] urachus or of an infected urachal cyst may escape via the umbilicus. Likewise, a purulent navel discharge may be caused by a suppurative ovarian cyst[25, 26] or a degenerating carcinoma of

the ovary.[1] Intra-abdominal abscesses secondary to perforation of the intestines resulting from a mesenteric thrombosis or from a strangulated hernia[21] may evacuate their contents through the umbilical ostium. Gallstones[20] and bile have both been extruded from the umbilical tract. Suppurative omphalitis[16] is rather common in infancy and may be due to a localized infection of the umbilical cord, to a persistent omphalomesenteric duct[15] or to a patent urachus.[15] Even empyemic cavities[8] resulting from a pneumonitis have perforated the diaphragm and poured their purulent contents through the umbilicus. Hence, a suppurative omphalitis is a serious condition and is usually associated with some grave abnormality. To consider them as mild superficial infections is to invite trouble. Recognition and correction of the underlying pathogenic factors are absolutely necessary if a cure is to be effected.

Before resorting to extensive surgical procedures the acute infection can usually be controlled by conservative measures. Absolute bed rest is essential, for it prevents continued irritation. Hot fomentations, antiseptic irrigations and gentle but persistent dilatation of the external umbilical orifice permit the pus to escape and the infection subsides. Not infrequently, the fistulous tract will evacuate a distended urachal cyst or drain the intra-abdominal abscess and also permit the concretion to escape, thus facilitating the later excision of the abnormal sinus. If there are no associated complications, one should never be satisfied with the mere extraction of the sebaceous plug. While such a procedure temporarily controls the inflammatory process, it does not prevent future recurrences. Even though widely dilated, the umbilical orifice again becomes stenosed and a reaccumulation of the cellular débris and secretions results in the formation of another concretion. It seems prudent, therefore, to excise the dilated umbilical tract during this period of quiescence. Women sometimes object to having the entire umbilicus excised because of the resulting deformity. In such instances, the umbilical cushion can be preserved as this gives the necessary "midline dimple," but the umbilical tract must be removed.

CONCLUSIONS

(1) In each of the four cases presented, the suppurative omphalitis was directly caused by the irritating effects of retained umbilical concretions.

(2) Stenosis or narrowing of the external umbilical orifice predisposes to the accumulation of sebaceous materials, desquamated epithelial cells, hair, and fibers of cloth which form these "umbilical concretions."

(3) These umbilical abscesses may drain externally or rupture intraperitoneally.

(4) Roentgenographic studies are valuable, not only in demonstrating the location and extent of the lesion but they depict associated complications, such as the presence of umbilical concretions, patent urachus, urachal cysts, or persistent omphalomesenteric ducts.

(5) Simple extraction of the sebaceous plug and antiseptic irrigations will usually control the infectious process but recurrences are almost inevitable, unless the dilated umbilical tract is excised.

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FEMORAL HERNIA IN THE MALE

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FEMORAL hernia in the male is a relatively uncommon condition as compared with inguinal hernia. Two thousand sixty-one inguinal herniae have been repaired at the U. S. Marine Hospital, Staten Island, N. Y., during the past six years as compared to 63 femoral herniae. This gives a relative frequency of 1 to 44. Thirty-five occurred on the right side and 28 on the left. There were five patients with bilateral femoral herniae.

Of these 63 femoral herniae 62 per cent were in men past the age of 40. The ages of patients with femoral hernia in this series are seen in Table I.

TABLE I

AGE INCIDENCE

3	20 to 30 yrs.
21	31 to 40 yrs.
26	41 to 50 yrs.
10	51 to 60 yrs.
2	61 to 70 yrs.
1	above 70 yrs.

A femoral hernia in its descent passes downward through the femoral ring. Beyond this ring the sac dilates and becomes globular or egg shaped and seldom descends more than two inches before treatment is necessary. As the sac enlarges it passes downward through the femoral canal and then pushes superficially through the saphenous opening, presenting beneath the skin of the thigh just below Poupart's ligament.

The neck of the sac is bounded above by Poupart's ligament, laterally by the femoral vein and medially by Gimbernat's ligament. Variations in the method of presentation of the sac include pectineal, multidiverticular, prevascular, and hernia occurring through Gimbernat's ligament. The latter two are rare. In the prevascular type the sac passes in front of the femoral vessels. While the neck of the usual femoral hernia seldom is over 1 cm. in diameter, the neck of the prevascular type may be sufficiently large to admit two or three fingers.

The origin of the femoral sac is uncertain. The majority of text-books state that it is a preformed sac, but give no reasons for such a statement. The following facts would seem to indicate that the femoral sac is not preformed but that it is a developmental condition of later life. If it was a preformed sac as many assert, as in indirect inguinal hernia, the age of occurrence would be expected to be at an age comparable to that of the occurrence

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of indirect inguinal hernia. Femoral herniae are rarely seen in children and in this series of cases only 4 per cent occurred before the age of 30 years. Sixty-two per cent occurred after the age of 40. If the femoral sac was preformed it would be expected to make its presence known frequently before the age of 20 and in the majority of instances before the age of 40.

A direct hernia is an acquired defect. It is the result of a continued or repeated strain at the site of a congenitally or acquired weakened inguinal region. Direct hernia occurs almost entirely in adults. In male children under 15 years of age direct hernia is a rarity. The same may be said for femoral hernia. Coley states, "The age of most frequent occurrence of direct hernia is between 30 and 40 years, seldom before 20." The same may be said for femoral hernia, with the addition that it is seldom seen before 30.

The indirect inguinal sac is conceded to be a preformed sac. Gray's Anatomy states that at the seventh month of fetal life a blind pouch or diverticulum forms. The testes enter this diverticulum and descend within it into the scrotum. At a later stage the connection between the tunica vaginalis and the abdominal cavity is usually obliterated. There remains, however, this preformed sac at the internal ring which may increase in size with time. It is a normal developmental condition.

In the direct hernia there is no preformed sac since there is no developmental change such as occurs in the descent of the testicle at the site of the indirect sac. Likewise the femoral region has no such developmental process. The nerve and iliac vessels are entirely extraperitoneal. In their development there is no firm adherence and no evident tension on the femoral peritoneum. If there were, the femoral sac should appear in childhood and early adult life.

I have made it a practice when performing an inguinal herniotomy to inspect the femoral region with my fingers in the abdomen through the opened indirect sac. In the young adult I do not find any relaxation about the femoral region. In older adults, not infrequently, however, with the relaxation of the abdominal wall and the formation of a direct sac, there is found a slight depression in the femoral region. This is an acquired condition just as is the direct sac. The facts as given above would seem to indicate that the majority of femoral herniae are not preformed.

Clinically, femoral herniae apparently give symptoms much earlier than do indirect and direct inguinal herniae. The symptoms may be at once pronounced so that the patient seeks relief by operation very soon after the hernia makes its appearance. In this series 89 per cent came for relief within one year after the symptoms began. Twenty-one per cent required relief within one month after the onset of symptoms. This differs from the usual inguinal hernia which may cause little discomfort for a long period after being noted. In femoral hernia strangulation may occur early. Three such cases were admitted with a strangulated loop of intestine. It is very common in opening a femoral sac to find a piece of incarcerated omentum. In two cases a Richter's hernia was found. In one the appendix was found in the femoral sac.

The only satisfactory method of treatment is surgical. The inguinal route is preferred for repair of all femoral herniae. Forty-two of the 63 cases reported here were repaired by the inguinal route. The majority of those not repaired by this method were operated upon previous to two years ago. During the past two years only four cases have been repaired by the usual femoral route. Two of these had previously had an inguinal hernia repair on that side which was sound. The other two had unusually sound inguinal regions.

The inguinal incision is preferred for two reasons. First, because it is possible to make a very much better repair, and second, it is very much safer to inspect the femoral opening from the intra-abdominal side before opening the femoral sac, than to try to incise and suture a fatty femoral sac which frequently contains incarcerated omentum and may contain an adherent or partially incarcerated Richter's hernia.

Operative Technic.—An incision is made in the inguinal region through the skin, fat and superficial fascia just as if an inguinal hernia was to be repaired. The external oblique aponeurosis is incised upward from the external inguinal ring and the cord isolated and retracted. Unless there is a well developed indirect inguinal sac in addition which requires opening, and there seldom is, a pouch of peritoneum at the internal inguinal ring is searched for and opened. In 1,955 inguinal herniae upon which I have operated during the past five years, many of which had been diagnosed direct herniae, I have never seen a patient in whom I could not find a slight bulging or protrusion of the peritoneum at the internal inguinal ring. By gentle traction the peritoneum at the site of the internal inguinal ring can be made into a sac one-half inch to one inch in size. The thin peritoneum can be incised without danger of injury to any abdominal viscera. A finger is inserted and the femoral opening is explored from within the abdomen. If a loop of intestine is adherent or a Richter's hernia is present, it is recognized at once. Omentum can be removed if it is not adherent and the size and extent of the femoral sac determined. In many cases the femoral opening can be inspected by placing a small retractor in the peritoneal opening at the internal inguinal ring. There is by this method no danger of injury to viscera as in the usual femoral repair.

The inguinal incision is retracted so that the femoral canal is exposed; the femoral sac is now isolated below Poupart's ligament in the femoral canal. The neck of the sac is transfixed, ligated and the sac removed. With a finger in the peritoneal opening at the indirect inguinal ring, it is placed against the ligated stump of the femoral sac. The needle still attached to the femoral sac ligature is passed through the ligated stump in the femoral canal below Poupart's ligament against the tip of the finger, into the peritoneal cavity. As the finger is withdrawn from the internal inguinal ring, the needle follows it until the tip can be picked up with a forceps through the peritoneal opening. It is passed through the inguinal peritoneal sac and the needle is removed. The other end of the femoral sac ligature is similarly manipulated except that it is brought out on the opposite side of the peritoneal opening

at the internal ring. They are then drawn upon and tied. This closes the peritoneal opening and brings the ligatured femoral stump and inguinal peritoneal sac together. The femoral stump, instead of remaining a funnel shaped protrusion, now has its apex pointing upward far inside the femoral ring. The congenital weakness of the peritoneum at the internal inguinal ring has been corrected. With the finger introduced from below Poupart's ligament through the femoral opening the stump can now be felt far up in the abdominal cavity. There are those who believe that high ligation of the femoral sac is the only step necessary in the repair of femoral herniae. In all herniae repaired at this hospital the femoral canal is now closed with interrupted mattress sutures of silk which brings Poupart's ligament in apposition with the pectineal fascia at its insertion into the superior ramus of the pubis. There is no difficulty in retracting the inguinal incision so that the suturing to close the femoral canal may be accomplished with ease. The mattress sutures are tied on the inner or medial side of Poupart's ligament. The conjoined tendon is then sutured to Poupart's ligament with seven or eight interrupted silk sutures. The cord is placed in position and the external oblique aponeurosis closed with silk. This makes a safer and sounder femoral hernia repair and is the operation of choice.

If the patient is aged or a poor operative risk or if the inguinal region is unusually sound, the usual femoral repair using a femoral incision below Poupart's ligament is indicated. In the poor risk patient, where the time element may have to be considered, the femoral incision may be better as the entire operation can be performed in less than 15 minutes while the inguinal approach requires approximately twice that period of time.

In a few instances, usually seen in recurring inguinal herniae, as the result of too tight suturing or infection, there has been a destruction of Poupart's ligament with only a few strands of stretched out Poupart's ligament remaining. Under such conditions there is usually noted a direct bulge above Poupart's, or what remains of it, and a bulge below Poupart's ligament. It is really a combined direct inguinal and femoral hernia. A satisfactory femoral repair cannot be made with a destroyed Poupart's ligament. I do not agree that high ligation of a femoral sac is all that is necessary in the repair of a femoral hernia. The femoral opening must be closed. This requires a Poupart's ligament or one that can be reconstructed. For this very difficult type, which fortunately is seldom encountered, a satisfactory repair may be effected by transplanting the tensor fascia lata muscle with its investing fascia lata to repair the defect. The usual inguinal herniotomy incision is made and the femoral sac and the few remaining fibers of Poupart's ligament exposed. The femoral sac is ligated, removed and the stump transfixed to the indirect inguinal peritoneal sac as described above.

An incision is then made seven to eight inches long over the course of the tensor fascia lata muscle. The size of the flap of fascia lata beyond the termination of the muscle fibers is determined and the flap is raised. The sartorius muscle is separated from the rectus femoris muscle in its proximal

three inches and the tensor fascia lata muscle is passed below it and transferred to the inguinal and femoral region.

The flap is placed superficially to the remaining fibers of Poupart's ligament and is sutured securely with silk sutures to the superior ramus of the pubis. The sutures pass through the periosteum on the medial side of the ramus of the pubis, the insertion of the pectineus muscle and the transposed fascia lata. Relatively little tension is necessary as we are dealing with a live muscle with intact nerve and blood supply. By passing the fascia lata graft superficial to the remaining fibers of Poupart's ligament undue pressure on the femoral vein is avoided.

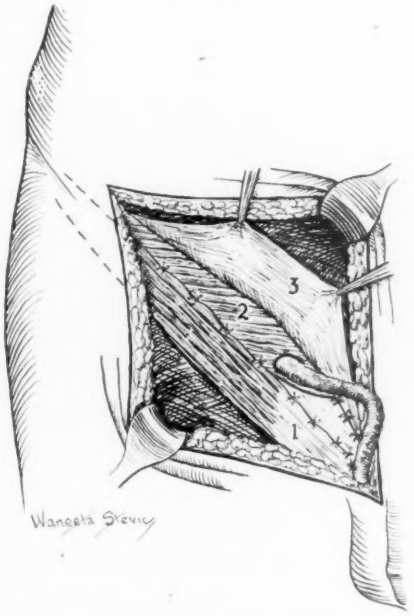

FIG. 1.—(1) Tensor fascia lata muscle transferred to the inguinal region. (2) The internal oblique and transversalis muscles are sutured to the tensor fascia lata muscle above the level of the internal inguinal ring. (3) The external oblique muscle retracted medially.

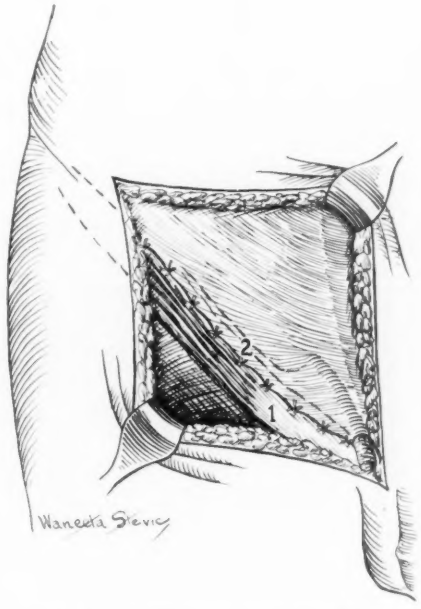

FIG. 2.—(1) The tensor fascia lata muscle has been sutured in place as described in Fig. 1. (2) The external oblique is brought down so that it overlaps the tensor fascia lata muscle and is sutured to it.

The newly constructed Poupart's ligament should be sutured to the superior ramus of the pubis as high up as the femoral vessels will permit, securely closing the femoral canal. The existing inguinal defect may be repaired by suturing the conjoined tendon to the fascia lata as it passes over the remains of Poupart's ligament (Fig. 1). The cord is placed in the inguinal canal. The external oblique aponeurosis is brought down over the flat surface of the tensor fascia lata and its enveloping fascia lata sheath and sutured in place with silk (Fig. 2).

In only two cases of femoral repair has this type of operation been required in the 63 cases. It does, however, offer a satisfactory method of repair in the unusual difficult femoral hernia in which there is an absence of a satisfactory Poupart's ligament.

Case Reports

Case 1.—No. 47710, was admitted to the hospital on July 2, 1934, for the repair of a recurrent hernia. He was 52 years old, and stated that he had had an inguinal hernia repaired in 1932. Two months later the hernia recurred. Examination showed a bulging in the inguinal and femoral regions apparently due to the loss of Poupart's ligament. He was operated upon on July 6, 1934. There was little of Poupart's ligament found. This allowed a protrusion into the femoral region and direct inguinal region. The tensor fascia lata muscle was transplanted to reconstruct Poupart's ligament as described above. Convalescence was uneventful although more prolonged than after a simple hernia repair. A period of 2½ months may be required before the postoperative discomfort has disappeared. Discomfort situated along the course of the tensor fascia lata muscle is the chief complaint. It is apparently due to the tension under which the tensor fascia lata is sutured.

The patient was instructed to return for an examination at intervals of 60 days. He has been examined on three occasions since the operation. The repair has remained sound. The last examination was approximately nine months following the operation.

Case 2.—No. 49795. A male, age 47, was admitted to the hospital for repair of a recurrent hernia. He had had a hernia repair in 1932. The hernia recurred in May, 1934. He was reoperated upon in July, 1934. The hernia recurred. At the time of examination there was a marked bulging into the direct inguinal region and into the femoral canal. A few strands of the remains of Poupart's ligament could be felt but it was markedly relaxed. He was operated upon February 18, 1935. At the time of operation a femoral and direct inguinal sac was found. There was little of Poupart's ligament remaining. The tensor fascia lata muscle was transplanted to reconstruct Poupart's ligament. Recovery was uneventful and he was discharged March 8, 1935. This patient returned for a follow up examination at two occasions at intervals of two months. The femoral region has remained firmly repaired. He was last examined in July, 1935.

SUMMARY

Sixty-three femoral herniae are reported which have occurred in adult males during the past six years, as compared with 2,761 inguinal hernia repairs during that same period.

The femoral sac occurs usually after the age of forty. Evidence seems to prove that the usual femoral sac is not a preformed sac but is a developmental condition just as is the direct inguinal sac.

The inguinal route for repair of femoral hernia is the method of choice.

For those cases in which the femoral sac is a part of a general weakness due to loss of Poupart's ligament from previous herniorrhaphy and infection, the tensor fascia lata muscle used as a pedicled transplant offers a satisfactory method of repair.

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CERVICAL RIB AND THE SCALENUS ANTICUS SYNDROME

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MOVEMENTS of the head, neck, and shoulder girdle which produce undue pressure on the brachial plexus and subclavian vessels are followed in time by pain in the neck, arm, and hand, or by circulatory and trophic changes in the upper extremities. When a roentgenogram of the cervical portion of the spinal column reveals either unilateral or bilateral rudimentary cervical ribs, the diagnosis is indicated, but when the same symptoms are present and cervical ribs cannot be demonstrated, the clinical condition known as the "scalenus anticus syndrome" has been suggested.

Cervical ribs have been classified according to size into four groups. Their size, however, is no index to the severity of symptoms, as the determining factor is their relation to the adjacent structures, the most important of which is the scalenus anticus muscle. This muscle arises from the anterior tubercles of the transverse processes of the third to sixth cervical vertebrae and it is inserted into the scalene tubercle of the first rib. It is this muscle that compresses the subclavian artery and the brachial plexus against the cervical rib; it may also elevate the first rib, producing an abnormal lift to that rib, compressing the subclavian artery, and elevating and irritating the brachial plexus. This in turn causes spasm of the scalenus anticus muscle, which is innervated by the irritated brachial plexus. Elevation of the shoulder girdle from this last named cause produces the same symptoms as do cervical ribs, and the condition has been designated by Ochsner and others as "the scalenus anticus syndrome."

Adson believes that the development of symptoms is attributable to two factors: (1) The muscular development of the young adult, whose bulging scalenus anticus muscle produces the symptoms, and (2) The sagging of the shoulder girdle of older persons, when there is an additional pull of the scalenus anticus muscle. According to Todd, compression of the subclavian structures results from abnormal development of the shoulder girdle. Normally, during intra-uterine and pre-adolescent development, the acromial end of the clavicle and the shoulder descend because of the weight of the upper extremity, and the sternal end of the clavicle descends because of contraction of the rectus abdominis muscle which is exerted through the sternum. No symptoms occur unless there is a greater than normal descent of the shoulder or an arrest of the descent of the sternum and the anterior ends of the ribs. Either one or both of these abnormalities

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will result in compression of the subclavian structures because of stretching of the brachial plexus and the subclavian vessels over a fixed cervical or first thoracic rib. According to Jones, symptoms of cervical rib are the result of an abnormal development of the brachial plexus. In cases in which the brachial plexus originates principally from the cervical segment of the spinal cord, no symptoms occur, whereas in those in which a considerable portion of the lower end of the brachial plexus is derived from the upper thoracic segments of the spinal cord, symptoms are likely to result from compression and angulation of the brachial plexus over the first rib or over cervical ribs.

The symptoms of compression of the brachial plexus and subclavian artery are usually pain, atrophy, numbness, or circulatory changes consisting of cyanosis, ulcers, and rarely, gangrene. Pain may be sharp and lancinating, or only a dull ache may be present. Pain usually follows the course of the nerves leaving the lower part of the trunk at the brachial plexus, but occasionally it may extend upward to the shoulder and into the neck. The pain may be more or less continuous, but it is invariably exaggerated by rotation of the head or by a forceful downward pull of the shoulder. Quite frequently there is a history of pain following any sudden or violent exertion, and women usually complain of pain and numbness along the course of the ulnar nerve following difficult labor. Hyperesthesia, paresthesia and anesthesia may be associated with pain and it may persist after strenuous exertion. Atrophy occurs late and is rarely complete; it may be of two types, the median or partial thenar type, and the ulnar type. In the former type there is paralysis of the abductor pollicis and opponens pollicis muscles, which are supplied from the seventh cervical nerve; the remaining thenar muscles are intact. The flexor pollicis brevis muscle is also supplied by the median nerve, but probably from a different segment. The ulnar type of atrophy, in which there may be paralysis of all the muscles of the hands except the two just mentioned, is the result of injury by cervical rib.

Circulatory symptoms are rarely severe, but they may manifest themselves in a dusky hue of the arm and hand as compared with the opposite upper extremity. There may be associated mild trophic changes in the tips of the fingers. Gangrene has been known to occur, involving one or more fingers; this usually is accompanied by obliteration of either the median or ulnar artery or both. Diminution in volume of the radial pulse is common; the pulse can be decreased or obliterated by having the patient elevate the chin or rotate the head to the affected side on inspiration. A diminution of the volume of the pulse on the affected side with a noticeable decrease of the surface temperature associated with numbness, coldness, and formication may be present. Ochsner found that the diminution in the volume of the pulse, as determined by oscillometer, is the most definite indication of the early vascular changes. Characteristically, the alteration of the oscillometric index, as determined by oscillograms, consists of a general decrease in the oscillations, particularly when the blood pressure reaches a high level. These symptoms vary in degree according to the amount of pressure over the subclavian

artery. Circulatory changes may be caused by constriction of the subclavian artery or subclavian vein, although Blair, Davies and McKissock agree with Telford and Stopford in the view that the changes are the result of irritation of the sympathetic fibers that pass to the distal arteries of the upper limb, and that they are not attributable to paralysis of sympathetic fibers. They based their opinion on the histologic examination of a brachial plexus in a case of cervical rib in which the vascular effects were pronounced.

The surgical indications for relief of symptoms of cervical ribs and for the relief of symptoms of the scalenus anticus syndrome are the same. As in other clinical conditions in which operation may offer relief, the severity of the symptoms enters into the surgical indications. A patient with mild symptoms and a low resistance to pain and discomfort usually is not as suitable for surgical treatment as one with more severe symptoms but who is stable.

Adson divided cases of cervical rib into three groups: (1) Those in which there is definite pain in the distribution of the brachial plexus but no circulatory disturbance and in which the patients are neurotic, (2) those in which symptoms are produced by anomalies in the supraclavicular triangle similar to those produced by cervical rib and the scalenus anticus syndrome, and (3) those in which definite symptoms are directly attributable to cervical rib. This last group he again divided into three subgroups: (a) Cases in which there is brachial pain with sensory or circulatory disturbances sufficient to incapacitate the patient, (b) cases of atrophy of the hand and arm on the affected side, and (c) cases of circulatory disturbance on the affected side without pain or atrophy sufficient to alter or obliterate the pulse on extension of the neck or rotation of the head. In the first group, operation is not in the majority of cases followed by satisfactory relief. In the second and third groups, however, the surgical treatment should be given careful consideration.

In a discussion of the scalenus anticus syndrome Ochsner emphasized the fact that there are certain clinical conditions which are likely to be confused, and that careful examination is necessary to rule out the possibility of cervical rib, subacromial bursitis, rupture of the supraspinatus tendon, cervicothoracic sympathalgia, Raynaud's disease, and brachial neuritis. However, the clinical picture of the scalenus anticus syndrome is identical with the foregoing symptoms of cervical rib.

The operation which has proved of greatest value for both cervical rib and the scalenus anticus syndrome is through the anterior approach described by Adson, which consists of an oblique incision about 5 cm. in length extending upward and backward from the sternoclavicular articulation into the posterior triangle. Dissection is then carried downward through the fat and platysma myoides muscle until the tendon of the sternocleidomastoid muscle and its attachment to the clavicle is exposed. This clavicular attachment is divided between two pairs of forceps; the muscle portion is then reflected mesially, exposing the tendon of the omohyoid and the tendinous attachment of the scalenus anticus muscle, and the phrenic nerve, which runs obliquely

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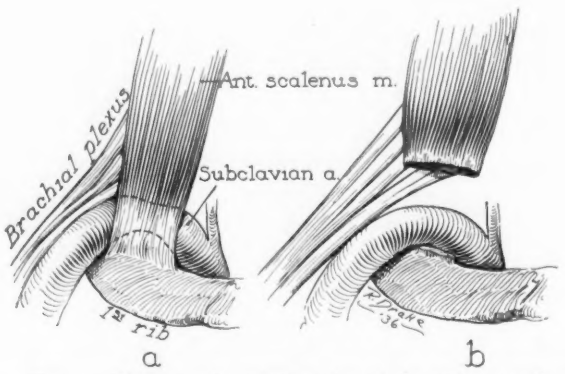

FIG. 1.—Diagrammatic representation of the scalenus anticus syndrome. (a) Compression of the subclavian artery and brachial plexus before operation; (b) relief of pressure and irritation after section of the scalenus anticus muscle.

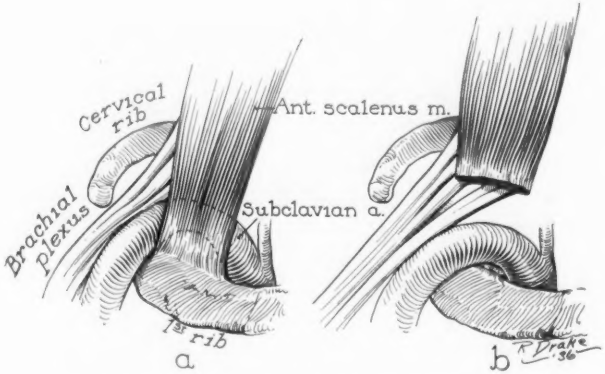

FIG. 2.—Cervical rib. (a) Rib does not compress the brachial plexus from behind; (b) relief by section of the scalenus anticus muscle.

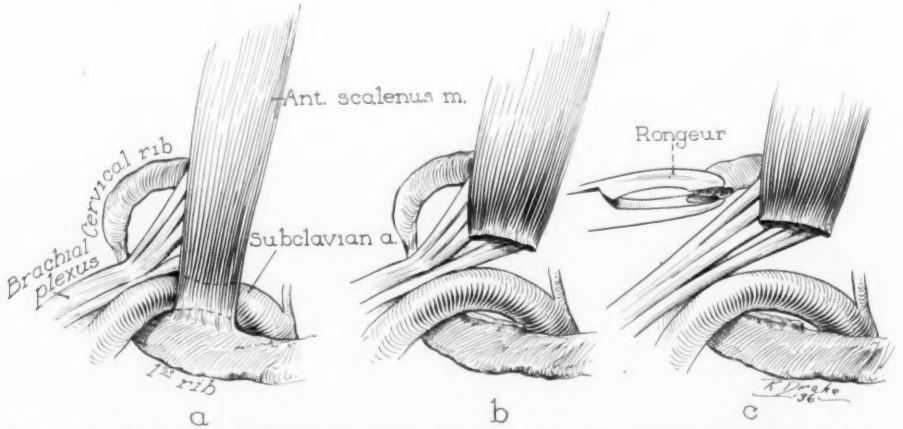

FIG. 3.—Cervical rib. (a) With tendinous attachments to first rib; (b) not relieved by section of scalenus anticus muscle; (c) pressure relieved by using a rongeur on the cervical rib.

across it from the lateral to the mesial border. The borders of the scalenus anticus muscle are dissected free and the phrenic nerve is retracted mesially before the tendinous and muscular fibers are divided. The subclavian artery will be seen lateral to the scalenus anticus muscle, and it usually is compressed against the trunks of the brachial plexus (Fig. 1). On the mesial side of the scalenus anticus muscle the pleura may be observed and, if dissection is carried still farther mesially, the carotid sheath and vertebral artery will be exposed.

It is important to carry the dissection upward along the anterior border of the scalenus anticus muscle for a distance of 5 cm. in order to expose the phrenic nerve thoroughly and to dissect it free before retracting it mesially. The fibers of the tendinous attachment of the scalenus anticus muscle at its insertion are then divided, care being taken that the subclavian artery and pleura are not injured. As soon as the scalenus anticus muscle has been divided, the subclavian artery can be dissected free and will then drop forward. After the scalenus anticus muscle has been divided, the cervical rib is carefully examined, and if it is causing no pressure from behind, no further operative treatment is necessary (Fig. 2). However, if the cervical rib or a tendinous attachment to the first rib seems to be compressing the brachial plexus from behind, a portion of the rib and tendon can be removed with a rongeur (Fig. 3). In cases of scalenus anticus syndrome, resection of the scalenus anticus muscle is all that is necessary.

In order to emphasize some of the points in the differential diagnosis and the surgical indications and results, the appended six case reports are detailed.

Case 1.—A male, age 21, came to the clinic complaining of weakness and wasting of the right hand which had been progressive over the previous four years. He first noted some weakness of his right hand and wrist when attempting to write, and was aware of the trouble also when he grasped a football to throw a forward pass. He attributed his disability to frequent injuries which he had sustained in football games and to the strain to which he subjected his right wrist while pole vaulting. This weakness had increased slowly for two years before he noticed that there was wasting and shrinkage of the muscles in the back of the right hand.

General examination gave essentially negative results, including a negative roentgenogram of the cervical portion of the spinal column for cervical ribs. Neurologic examination revealed loss of strength and tonus of the interosseous muscles with marked atrophy. There also was marked atrophy of the hypothenar muscles, with weakness of the adductor muscle of the right thumb. There were no sensory changes but a definite sharp pain extended down the right arm to the fingers when the patient flexed his head on his thorax. The blood pressure in both arms was normal. The radial pulse was obliterated bilaterally on extension of the head with deep inspiration. A diagnosis of scalenus anticus syndrome was made and operation was advised.

Under ether anesthesia, the right and left scalenus anticus muscles were divided. Both scalenus anticus muscles were about three times normal size as were all the other muscles in the neck on account of the patient's athletic activities. Immediately on division of the scalenus anticus muscles the subclavian artery was released where it had been compressed against the brachial plexus; the compression was more pronounced on the right than on the left side. Following the operation the pain was entirely relieved, the radial pulse could not be obliterated on extension of the head with deep inspiration, and within a year the right hand had assumed its normal appearance and strength.

Case 2.—A male, age 20, had operated a hydraulic press three years prior to his admission to the clinic and had noticed that at the end of the day his arms would ache and feel numb. After a month these symptoms had become so severe that he changed his job for lighter work and his symptoms disappeared. Three weeks before admission to the clinic he again took up a heavy type of work and began having shooting pains down his left arm, associated with tingling of the fingers. He noticed that his pain was always worse in the evening and that it occasionally kept him awake at night. He occasionally also complained of the same type of pain in his right arm. Roentgenograms of the cervical portion of the spinal column gave no evidence of cervical ribs. Both radial pulses could be obliterated on extending the head during inspiration. A diagnosis of scalenus anticus syndrome was made, and the scalenus anticus muscles were divided bilaterally and were found to be compressing the subclavian artery and the brachial plexus. This pressure was completely relieved at operation, and, after an uneventful convalescence, the patient returned to the same type of work which had been causing his symptoms and remained free from pain and discomfort.

Case 3.—A female, age 34, four years prior to examination had noticed the gradual onset of a peculiar feeling in her hands and shoulders which she described as pain, tingling, and numbness. This had been greatly aggravated by her work as a stenographer. The symptoms first developed in the left hand and soon involved the entire arm; the right arm then became involved. The symptoms became so severe that it was necessary for the patient to stop typing and rub her hands and shake them several times a day in order that she might proceed with her work.

On examination tenderness was present in both supraclavicular fossae, but a roentgenogram of the cervical portion of the spinal column revealed no signs of cervical ribs. There was almost complete obliteration of the radial pulse on both sides on extension of the head. A diagnosis of scalenus anticus syndrome was made. Bilateral resection of the scalenus anticus muscle revealed compression of the subclavian artery and irritation of the brachial plexus. Following recovery from the operation the patient returned to work and remained completely free of her previous symptoms.

Case 4.—A male, age 22, four months prior to examination had taken a job as riveter. He soon noticed that numbness and tingling, involving his arms and hands, developed while he was working, and that, in addition, in cold weather his hands would become cold and blue. As long as his hands and arms were at his sides he had no symptoms, but when they were raised at right angles to his body, this numbness and tingling appeared.

A roentgenogram of the cervical portion of the spinal column revealed bilateral cervical ribs and the radial pulse could be obliterated on extension of the head. Bilateral resection of the scalenus anticus muscles was performed and the compression of the subclavian artery was relieved. The patient returned to his work as a riveter and had no further trouble, even in cold weather.

Case 5.—A male, age 48, since the age of 16 had noted intermittent numbness in the fingers of both hands; this was worse on the right side. He noted that the numbness came on during the night, especially if he slept with his head on his arm. He said that he had noticed that he could produce this numbness any time he elevated his arm, as in driving a car or in doing overhead work. He had also noticed that this numbness disappeared in from five to ten minutes after replacing the arms in a dependent position. In view of the fact that he was an electrician his symptoms were incapacitating.

On examination there was almost complete obliteration of the radial pulse in both arms on extension of the head, and a roentgenogram of the cervical segment of the spinal column revealed bilateral cervical ribs. At operation the scalenus anticus muscle was seen to be compressing the subclavian artery on both sides, posteriorly, against the brachial plexus and bilateral resection was performed. The patient returned to his occupation as electrician and was completely free from symptoms.

COMMENT.—In the preceding cases the symptoms of cervical ribs and scalenus anticus syndrome have been very similar, and the surgical treatment has been the same because, by division of the scalenus anticus muscle, the subclavian artery and the brachial plexus have been decompressed, following which there was a complete alleviation of symptoms. The question has arisen with regard to the surgical disposal of the cervical rib, when at operation it is evident that pressure is being produced by the rib on the brachial plexus from behind. Adson has demonstrated that the anterior approach, with section of the scalenus anticus muscles, is the operation of choice. It is much more satisfactory than the lateral or posterior approach. In fact, it is now realized that complete removal of the rib is not as important as relieving the pressure on the brachial plexus and subclavian artery. The following is a case requiring more than the usual resection of the scalenus anticus muscle for the relief of symptoms:

Case 6.—A female, age 16, had first noticed at the age of five an intermittent pain in the neck and right supraclavicular space which was aggravated by lying down. Two years prior to her examination this pain had become worse; it was more constant and became quite severe when she used her right arm. A year before examination the pain became more severe, and it was projected down the inner aspect of her arm and involved the third and fourth fingers. Six months later she noticed continuous slight numbness of the third and fourth fingers.

On examination there was a definite tumefaction in the supraclavicular fossa on the right, and the pulse could be obliterated by direct pressure, although not by extending the head. A roentgenogram of the cervical segment of the spinal column revealed a large cervical rib on the right. At operation, the usual section of the scalenus anticus muscle was performed, and the cervical rib was found to be attached to the first rib by a tendinous attachment which pressed on the brachial plexus from behind. This attachment was severed with a rongeur, but as the rib still produced some pressure, the entire rib was removed in sections and the brachial plexus was dissected free. Following this there was no pressure on the brachial plexus and the subclavian artery was pulsating normally. The patient was completely relieved of pain and anesthesia in her right hand and arm.

SUMMARY.—The clinical picture of cervical ribs and that of the scalenus anticus syndrome are very similar, as are also the surgical indications and operation. The symptoms result from compression or irritation of the brachial plexus and compression of the subclavian artery. Compression may be due to the presence of cervical rib, an abnormally low position of the shoulder, high fixation of the sternum and ribs, low origin of the brachial plexus, or elevation of the first thoracic rib from spasm of the scalene muscles brought about by irritation of the brachial plexus. When cervical ribs cannot be demonstrated, resection of the scalenus anticus muscle is usually all that is necessary to relieve the symptoms. In the presence of a cervical rib without tendinous attachments and without obvious pressure from behind, resection of the scalenus anticus muscle is all that is necessary, but when there is evident pressure from the cervical rib or its tendinous attachment, resection of the rib and the attachment should be carried out.

In carefully selected cases in which the symptoms point clearly to either cervical rib or the scalenus anticus syndrome, the surgical result is usually

excellent. Six cases are presented to illustrate the points in differential diagnosis, surgical indications, and results.

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FIBROUS OSTEOMA OF THE JAWS

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TUMORS of the jaws have to be considered apart from tumors of bone in general. In the first place, many of them are of dental origin which precludes their occurrence in other bones. In the second place, the jaws belong to the group of bones preformed in membrane which differ considerably in growth, repair, and tumor formation from the bones preformed in cartilage.

Embryologic Considerations.—The maxilla and mandible as well as other bones of the face and cranial vault are derivatives of the scaly armor, dermal bone, or exoskeleton which appears first in the early fishes in the scale of evolution.[1] In higher forms this sinks beneath the skin, articulates with the endoskeleton or cartilage preformed bone and forms in the human the bones that ossify in membrane. Even the mandibular articulation is not related to the earlier cartilaginous gill bars but is rather a secondarily formed diarthrosis between two of these membrane bones.

The maxilla ossifies in membrane from three centers on each side, the maxilla proper, the premaxilla, and the prevomer. During its ossification a cartilaginous mass develops in the malar process which, according to Fawcett,[2] probably is either an accessory cartilage or the anterior end of the palato-pterygo-quadrate cartilage. Membranous ossification of the maxilla extends from these three fused centers laterally to include this cartilage, and medially to incorporate part of the lateral wall of the cartilaginous nasal capsule. Thus, while cartilage is present in the field in the embryologic stages, none of the bone of the maxilla appears to be laid down by ossification of it.

The mandible ossifies from one center on either side. This center represents the dentale, a dermal bone present in lower vertebrates. Intramembranous ossification spreads from it to form the body and ramus of the mandible. There are two types of cartilage which develop in the embryonic mandible and become incorporated in the spreading membrane bone. The first is a remnant of Meckel's cartilage. This is an important structure in lower vertebrates. In the newborn infant, however, it is represented only by a small connective tissue cord, the sphenomandibular ligament, and by a scanty cartilaginous remnant extending along the dental canal to a position just back of and below the incisor teeth. The second type of cartilage to be incorporated into the mandible is the so called accessory cartilage that develops at the articulation, along the posterior edge of the ramus and the anterior edge of the coronoid process, and at the symphysis. Sections through these cartilaginous areas in the newborn show signs of growth by a somewhat atypical enchondral ossifi-

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cation. Benign tumors that contain cartilage and ossify through cartilage may arise in the jaws. Five such, four benign and one malignant, have been studied by us. They probably originate in connection with remains of these embryonic cartilages, since the relative amount of cartilage present is great.

Repair of fractures and of defects in the mandible and maxilla is by the formation of callus which is fibrous in its first stage and which ossifies usually by direct metaplasia without the appearance of cartilage. However, experiments by Schaffer,[3] Greve[4] and others to be published by one of us (K. S. G.) demonstrate that in the later stages of ossification of the callus and especially when fracture fragments are separated, hyaline cartilage in small amounts may appear and be replaced by new bone by enchondral ossification similar to the callus of a bone preformed in cartilage.

That the great majority of benign ossifying tumors of the jaws are free from cartilage and consist almost entirely of fibrous tissue and bone is to be anticipated from the fact that these bones grow normally by membranous ossification. The findings in the cases to be reported and in those reviewed from the literature substantiate these views. They have been variously designated in the literature as fibrous osteomata or ossifying or osteofibromata, usually according to whether bony or fibrous elements predominate in the particular tumor.

Thirteen cases presenting this lesion, four in the maxilla, eight in the mandible, and one in both bones, have been studied. Two others of the maxilla previously reported by Montgomery[5] are briefly reviewed and illustrations of their pathology included.

A. Fibrous Osteomata of the Upper Jaw

Case 1.—M. S., white, female, age 15, was admitted with the history of a growth that had been noticed on the external surface of the right maxilla above and in the region of the first two molars for two years. Examination revealed essentially normal findings with the exception of a swelling of the anterior and anterolateral portion of the right maxilla and a thickening of its entire alveolar margin. Figure 1 shows the roentgenologic appearance at that time. There is a dense shadow occupying the inferior and lateral half of the right antrum and expanding the walls of the maxilla laterally and inferiorly.

At operation the mucous membrane over the tumor was incised and soft spongy bone comprising the tumor was removed with the exception of portions at the orbital margin, about the roots of the teeth, and in the region of the malar bone. The tumor was found to fill about one-half of the region of the antrum. No unossified areas were found.

Microscopic sections (Fig. 2) consist of trabeculated bone with cancellous spaces filled by immature fibrous tissue. Practically no hemapoietic cells were present. There are rows of osteoblasts along some of the trabeculae. The diagnosis was fibrous osteoma.

The patient received postoperatively 510 roentgen units in divided doses over three months. Six and one-half years later there is no evidence of progression of the tumor and the face is symmetrical.

Case 2.—W. P., white, male, age 11, had had a gradually increasing enlargement of the anterolateral region of the left maxilla for three years. Examination revealed no abnormalities other than a bony hard tumor in the anterior and lateral portion of the maxilla and including the alveolar process.

The patient was operated upon by Dr. Frederick Moorhead February 4, 1920. A longitudinal incision was made in the mucous membrane of the gum of the left maxilla

and the underlying bony tumor was exposed and chiseled and curetted away. The cavity was packed with gauze.

The specimen consisted of numerous small and large fragments of spongy bone.

FIG. 1.—(Case 1.) Roentgenogram of the tumor of right maxilla.

FIG. 2.—(Case 1.) Photomicrograph of tissue removed.

Microscopic examination (Fig. 3) shows the tissue to be composed of fine bony trabeculae and of a fibrous marrow. The relative amounts of marrow and trabeculae vary in different regions, but nowhere are large islands of purely fibrous tissue seen. Newly forming

FIG. 3.—(Case 2.) Photomicrograph of tissue removed showing spongy bone, fibrous marrow and giant cells.

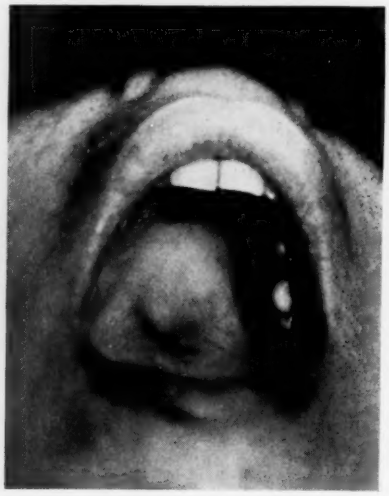

FIG. 4.—(Case 3.) Photograph of the osteoma of hard palate at seat of palatine torus.

trabeculae are numerous. Scattered throughout the sections are numerous large foreign body giant cells. There are no evidences of mitosis. The diagnosis was fibrous osteoma.

This tumor is almost identical with that in Case 1 except for the scattered areas containing giant cells. About ten years after operation the growth had remained controlled.

Case 3.—J. McM., white, female, age 29, was admitted with the history that five years ago she first noticed a swelling of the hard palate (Fig. 4). During the last three months the overlying mucosa had become slightly ulcerated. There had been no period of rapid growth.

Examination revealed a bony hard tumor 2 cm. in diameter bulging down from the posterior portion of the middle of the hard palate, a distance of 1 cm., and a small superficial ulcer in the mucosa. A roentgenogram revealed an oval shadow of increased bone density in the region of the swelling.

Under local anesthesia a 2½ cm. incision was made through the mucosa of the palate and the oval protruding tumor was chiseled off sufficiently to give the palate its normal contour.

Microscopic examination showed a dense cortical bone with small marrow spaces

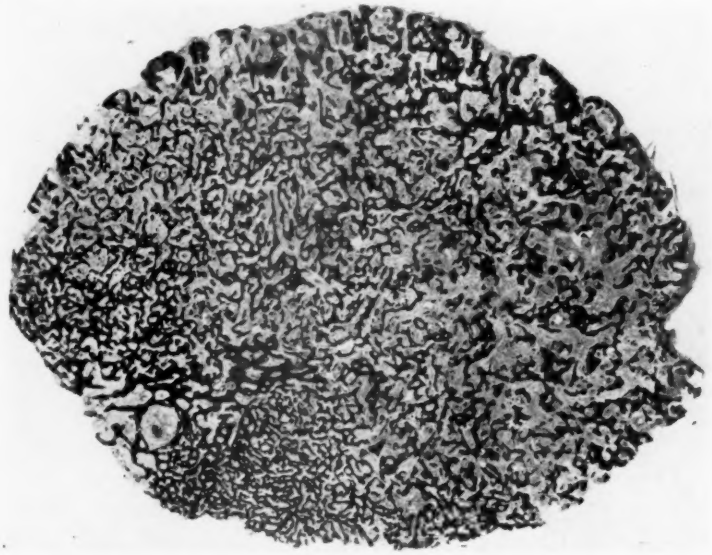

FIG. 5.—(Case 4.) Photograph of a section at middle of excised tumor.

containing partly fibrosed and partly fatty and hematopoietic marrow. Beneath this cortex was a loose cancellous bone with large irregular marrow spaces that contained a fatty marrow in which a sparse sprinkling of hematopoietic cells was present. This cancellous bone was penetrated by one broad and one narrow band of more compact spongy bone. The trabeculae of the latter stained heavily with hematoxylin and were separated by a richly cellular completely fibrous marrow.

This lesion was at the site of occurrence of the palatine torus and might be regarded as an unusually large hyperostosis but the presence of much fibrous marrow in the cancellous bone makes it seem more logical to classify it as an osteoma. H. C. Greve[6] is of the opinion that large tori are osteomata.

Case 4.—M. B., white, female, age 28, had noticed a small lump on the maxilla adjacent to the left side of the nose eight years previously. It had enlarged very slowly. Examination was essentially negative except for the bony hard swelling which bulged forward from the maxilla just beneath the mesial orbital margin and measured about 2½ cm. in diameter at its base. The Wassermann was positive.

In July, 1913, an oval bony tumor 2 x 2 x 2½ cm. was removed. Microscopic examination of a section taken through the middle of the entire tumor (Fig. 5) showed it to be made up of fairly dense cancellous bone containing a fibrous marrow which was richly cellular in some regions and markedly collagenous in others. There was a thin

irregular cortex along the external surface. There was a very small amount of fatty and hematopoietic marrow present. The trabeculae in several large areas were more slender, more continuous, and more closely adjacent. There were no areas of active new bone formation and no large areas of fibrous tissue. The marrow spaces were filled with fibrous tissue that was quite mature, with areas in which the cells were separated by numbers of collagen fibers. No areas of fatty or hematopoietic bone marrow were present. Diagnosis: Fibrous osteoma of maxilla.

We have had occasion to study the pathology of Cases 2 and 3, reported by Montgomery, and are reviewing them with the inclusion of illustrations which were not in his publication.

Montgomery's **Case 2.**—A male, age 66, had had a tumor removed from the right maxilla 12 years before, but it had recurred in the posterior alveolar region where there was a large oval protruding mass which was bony in its anterior portion and soft posteriorly. A roentgenogram (Fig. 6) shows dense bony shadow in the region of the antrum. At the posterior limits of the maxilla is a shadow of a tooth obliquely placed but with absence of a bony shadow between it and the antrum. Above and anterior to the dense shadow in the region of the antrum is the shadow of a second tooth. There are no shadows of any of the other teeth in the upper or lower jaws.

FIG. 6.—(Montgomery's Case 2.) Roentgenogram of the tumor of maxilla, partly ossified. Unossified portion displaces tooth backward.

The maxilla, including the tumor, was resected. The specimen was sectioned sagitally. Its anterior and superior portions consisted of bone. There was a tooth imbedded in the anterior portion and in the superior portion there was a yellowish dense calcified area. The posterior and inferior two-fifths, which had grown recently, consisted of soft tumor covered inferiorily and laterally by mucous membrane. There was a tooth imbedded in its posterior portion.

Microscopic examination of the ossified portion showed it to consist of dense cancellous bone. The marrow spaces in the regions that bordered on the soft tumor were filled with fibrous marrow, while some of those more remotely situated contained fatty and hematopoietic marrow. The dense yellow area in the superior part of the specimen consisted of calcified connective tissue which was undergoing bony replacement at its periphery (Fig. 7). Sections of the soft tumor consisted for the most part of immature connective tissue with wavy collagen fibers and oval to spindle shaped cells. There were mucoid regions in which collagen fibers and cells were few. At the junction of the ossified and unossified portions there were newly formed trabeculae extending into the soft tumor. The diagnosis was ossifying fibroma or fibrous osteoma with areas of calcification and mucoid degeneration.

Montgomery's **Case 3.**—A male, age 62, had a hard inverted tongue like projection of 18 years' duration from the hard palate into the mouth. The tumor was removed. It was reported by Montgomery. We have had occasion to study the pathology of the tumor and are presenting illustrations of it here. Figure 8 is a photograph and Figure 9 is a roentgenogram of the excised tumor. More than one-half of the tumor consisted of soft tissue. The superficial portion was fibrous with a covering of mucous membrane but

its deeper portion consisted of bone which extended into the tumor and sprang from the maxilla.

Microscopic examination (Fig. 10) showed that the soft portion consisted of fibrous tissue which in most of its extent was rich in irregularly coursing strands of collagen

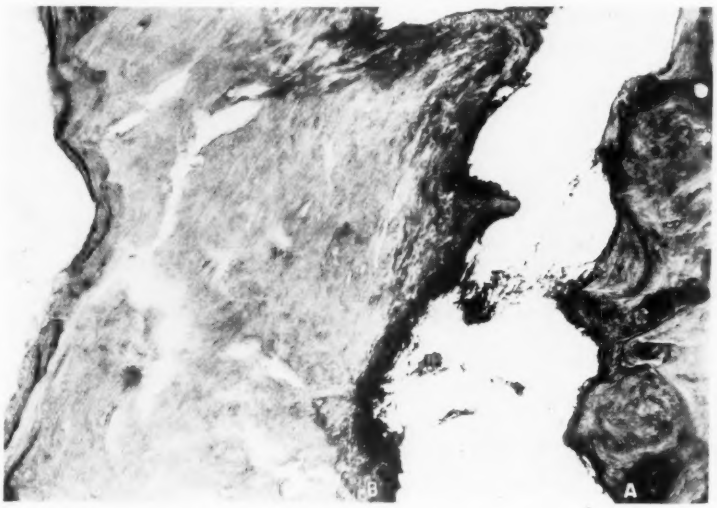

FIG. 7.—(Montgomery's Case 2.) Photograph of tumor removed showing fibrous area partly calcified. (A) Bone; (B) Calcified area; (C) Fibrous area.

fibers and contained a variable number of spindle shaped nuclei. In other places there were large mucoid spaces that were poor in collagen fibers and contained scattered branching and pyramidal nuclei. The base of the tumor contained dense mature bone with fibrous marrow from which irregularly branching rays of bone extended into the soft parts.

FIG. 8.—(Montgomery's Case 3.) Photograph of buccal surface of tumor removed.

FIG. 9.—(Montgomery's Case 3.) Roentgenologic appearance of the tumor removed (Fig. 8).

Diagnosis: Because of the predominance of fibrous tissue in the case the term "ossifying myxofibroma" is more appropriate than fibrous osteoma, although eventually the entire tumor might have ossified.

B. Fibrous Osteomata of Lower Jaw

Case 5.—A female, age 29, was admitted with the history that at the age of 12 she had first noticed a tumor of the left side of the body of the mandible. Several teeth were then removed from the involved area. At 16 the tumor was partially excised. Sections obtained of the tissue (Fig. 11) showed trabeculated bone with the cancellous spaces filled with richly cellular fibrous marrow. There are scattered giant cells and rows of osteoblasts along the trabeculae.

Fig. 10.—(Montgomery's Case 3.) Photomicrograph of the tissue at junction of bone and soft part of tumor shown in Figure 8.

The tumor had slowly enlarged. Examination at the time of admission was essentially negative except for an oval swelling of the left half of the mandible which extended from the left angle of the jaw forward to the symphysis. There was a loss of sensation in the mucocutaneous distribution of the mental nerve. The mass bulged lingually about 1 cm., bucally about 2½ cm., and dentally about .5 cm. It extended above the level of the remaining lower teeth, and in places showed the impressions of the upper teeth. Serum calcium and inorganic phosphate were respectively 10.06 and 4.42 mg. per cent.

A roentgenogram (Fig. 12) showed an oval expansion of the bony shadow of the entire left half of the body of the mandible of fairly uniform density. The cortical shadow

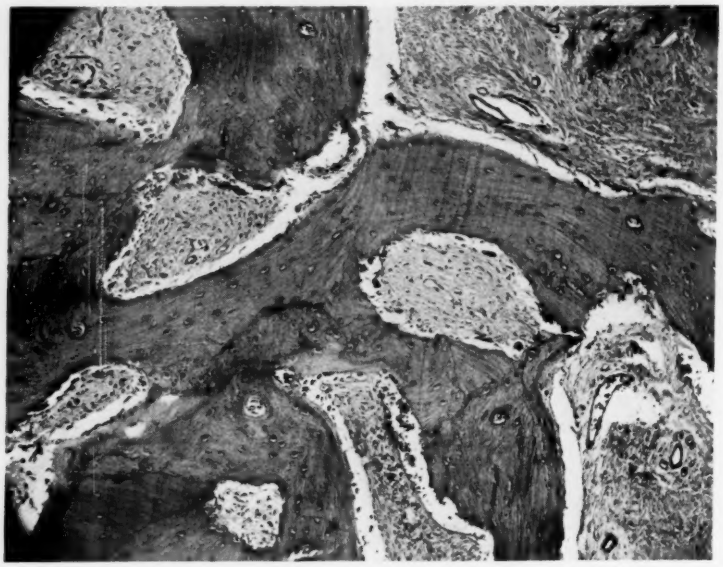

Fig. 11.—(Case 5.) Photomicrograph of tissue removed.

was greatly thinned. An incision was made along the lateral alveolar margin and the periosteum and soft parts reflected downward to expose the bony enlargement. Thirty-five grams of dense spongy tumor bone were chiseled away from the lateral surface to

restore the normal external contour of the mandible. The cortex varied in thickness, being very thin in some places. The tumor removed consisted uniformly of very dense spongy bone. No areas of softening were found.

Microscopic sections showed the same type of spongy tumor bone with fibrous marrow, osteoblasts and scattered giant cells as that removed at the first operation. Diagnosis: Fibrous osteoma. The patient made an uneventful recovery. Four months later there had been no recurrence of the swelling.

Case 6.—A female, white, age 12, was admitted to Presbyterian Hospital with the history that six years previously a bean sized tumor of the gum of the right side of the mandible had been excised. It recurred and ten months later had grown to the size of a hen's egg. Treatment with cautery and radium had failed to stop its growth. At the

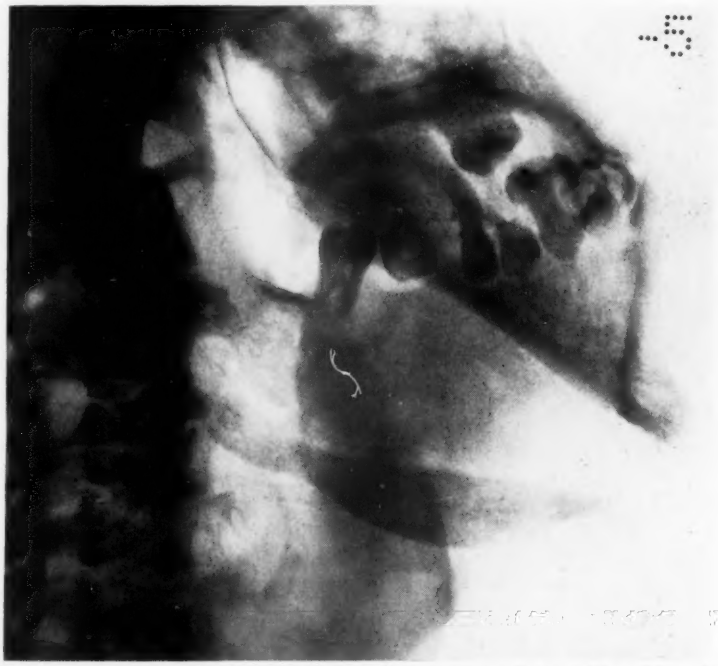

FIG. 12.—(Case 5.) Roentgenogram of the jaw 13 years after partial excision of tumor.

time of admission there was an enormous, firm, oval swelling of almost the entire body of the mandible on both sides. On the right side all the teeth but the last molar had been extracted, while the five remaining teeth on the left side were markedly displaced.

A roentgenogram (Fig. 13) showed loss of the normal shadow of the body of the mandible except about the left angle. There were radiating streaks of faint bony density extending outward into the faint shadow of the tumor which replaced the body. There were two shadows of radon seeds in its anterior portion.

At operation the entire tumor was removed en masse by Doctor Gatewood. Figure 14 is a photograph of the superior surface and Figure 15 of the cut surface of the excised specimen. The tumor consisted of firm, gray, soft tissue containing scattered radiating trabeculae of bone (Fig. 16).

Microscopic examination (Fig. 17) showed it to consist of loose fibrous and myxomatous tissue containing a few radiating spicules of bone. There were no signs of mitosis. Along the periosteal surface, at a point where bony spicules came to the periphery, there was a very thin layer of calcified cartilage which was being replaced by bone and appeared to be formed from the distended periosteum. This was the only

region in which cartilage was seen in the tumor. Two explanations for the presence of this cartilage have to be considered. One is that the tumor arose in bone that was preformed in Meckel's cartilage. By far the more probable explanation is that the tumor arose from membrane, and that in the process of rapid growth a small amount of cartilage appeared in the process of ossification similar to that frequently seen in tumors and proliferative processes in the long bones and occasionally in the healing of fractures of the mandible. Since the fibrous element greatly predominated over the bony, the most appropriate name for the lesion would be ossifying fibroma.

The operative defect was repaired by a curved rib transplant and the chin was subsequently built up by a series of plastic operations. There has been no recurrence of the tumor in the nine year interval following the operation. However, the deformity is still severe and the case illustrates the necessity for avoidance of extensive resection of bone when possible.

FIG. 13.—(Case 6.) Roentgenogram of the tumor showing it replacing the mandible and containing faint radiating bone; also two radon seeds.

Case 7.—A report of this case has been previously published.[7] A résumé with illustrations is given here.

M. O'N., white, female, age 18, had a hard oval swelling in the left anterolateral surface of the body of the mandible that had been gradually increasing in size for four years (Fig. 18). On examination the tumor was of bony hardness. Within the mouth it extended from the second left molar anteriorly and around to the right bicuspid. It also extended upward into the alveolar process about the base of the teeth.

A roentgenogram (Fig. 19) revealed the shadow of a large oval swelling of the mandible with a thin dense cortex and a faint mottled interior. The tumor was removed through an inframental incision and the defect was repaired with a horseshoe shaped transplant cut transversely from the upper end of the tibia. On section there was a thin bony cortex and interior filled with firm soft tissue throughout which were scattered small islands of bone.

Microscopic examination showed it to consist of a richly cellular immature fibrous tissue scattered throughout which were islands of spongy new bone. Diagnosis: Ossifying fibroma. Figure 20 shows the cosmetic result 16 months afterwards. There had been no recurrence of the tumor three years postoperatively.

Case 8.—E. B., female, white, age 37, had noticed a swelling of the gum of the right side of the mandible eight months before admission, since which time it had very slowly increased. Four months previously a biopsy was taken which showed a mozaic pattern of bony trabeculae and fibrous marrow.

Examination was essentially negative except for a hard, smooth, oval swelling involving both sides of the body and part of the ramus of the mandible on the right side. The body measured 3 cm. in thickness. The teeth were slightly irregularly displaced. Serum calcium and serum inorganic phosphate were respectively 9.89 and 3.34 mg. per cent.

A roentgenogram (Fig. 21) showed diffuse reduction in density with mottling of the shadow of the body and ramus of the right half of the mandible, and a thinning of the shadow of the cortex which was enlarged ovally along the inferior margin.

An incision was made in the buccal mucosa extending from the angle of the jaw forward slightly past the midline. The soft parts were reflected and a strip of the thin

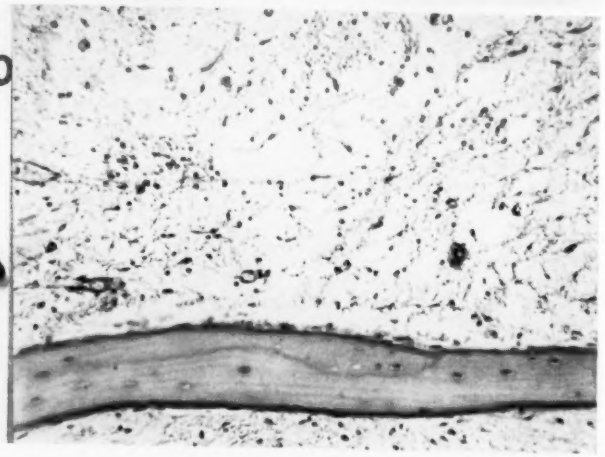

FIG. 14.—(Case 6.) Resected mandible as seen from above.
FIG. 16.—(Case 6.) Roentgenogram of bisected specimen.

FIG. 15.—(Case 6.) Horizontal section of specimen.
FIG. 17.—(Case 6.) Photomicrograph of ray of bone and soft tumor.

cortex running the entire length was removed. The spongy bone of the interior was curetted out exposing the roots of the teeth in places and damaging the mandibular nerve and artery. The overlying mucosa was sutured and a gauze drain inserted.

FIG. 18.—(Case 7.) Photograph of patient preoperatively.

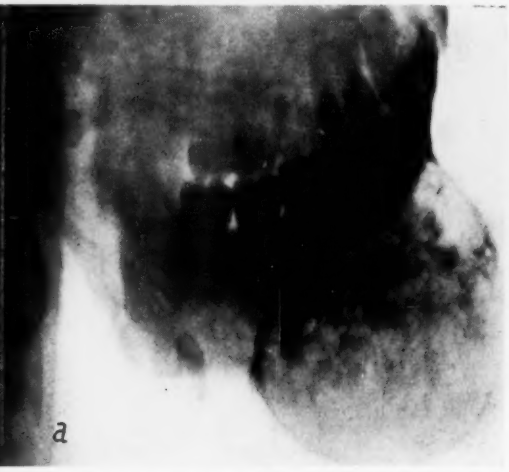

FIG. 19.—(Case 7.) Roentgenogram of jaw.

Microscopic sections (Fig. 22) show the tumor to be composed of a mixture of cancellous bone and fibrous tissue. In some places the bone was dense and mature, while in others it was extremely spongy and immature. The unossified portions consisted of spindle cells with bands of collagen fibers in many areas and numerous small vascular spaces. Giant cells were frequent in some places. There is no evidence of cell division. Diagnosis: Fibrous osteoma.

FIG. 20.—(Case 7.) Photograph 16 months postoperative, showing the cosmetic result obtained by the bone transplant after removal of the tumor.

The wound healed with little inflammatory reaction. The patient then received 1,465 roentgen units to the region of the right half of the mandible in divided doses. Ten months after operation there was no sign of recurrence of the tumor.

Case 9.—A. G., female, white, age 41, was admitted with the history that nine years previously a dentist extracted several teeth and told her that she had a tumor of the mandible. It was then operated upon and subsequently had very slowly enlarged.

Examination at the time of admission was essentially negative except for the right mandible. The molars and second premolars were absent. The right side of the body of the mandible was enlarged from the region of the first premolar backward about 4 cm. Its width was about 2½ cm. The enlargement involved the inner and outer surfaces of the jaw about equally. Serum calcium and inorganic phosphate determinations were respectively 10.04 and 4.21 mg. per cent.

A roentgenogram (Fig. 23) revealed a large oval area of reduced density in the middle portion of the right body of the mandible with a jagged circular area of greater density in its central portion. No tooth shadows are in the involved region.

At operation an incision was made near the alveolar margin on the buccal and lingual

FIG. 21.—(Case 8.) Roentgenogram of the tumor of body of mandible.

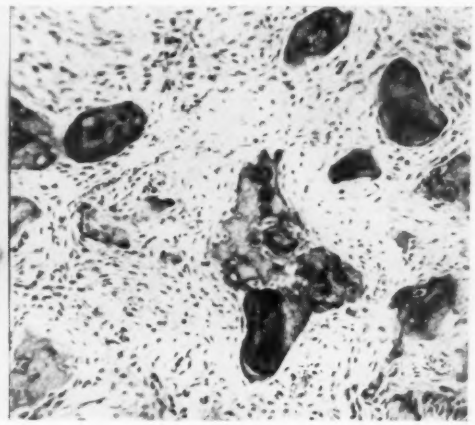

FIG. 22.—(Case 8.) Photomicrograph of the tissue removed.

sides of the involved region and enough of the tumor was removed to give the bone its normal contour.

Microscopic examination (Fig. 24) revealed a dense mature bone with fibrous marrow which partitions irregular islands of partly fibrous and partly ossified tumor tissue. The ground substance of the spongy tumor consisted of an abundance of spindle cells arranged in whorls and bands among various numbers of collagen fibers. Scattered through most

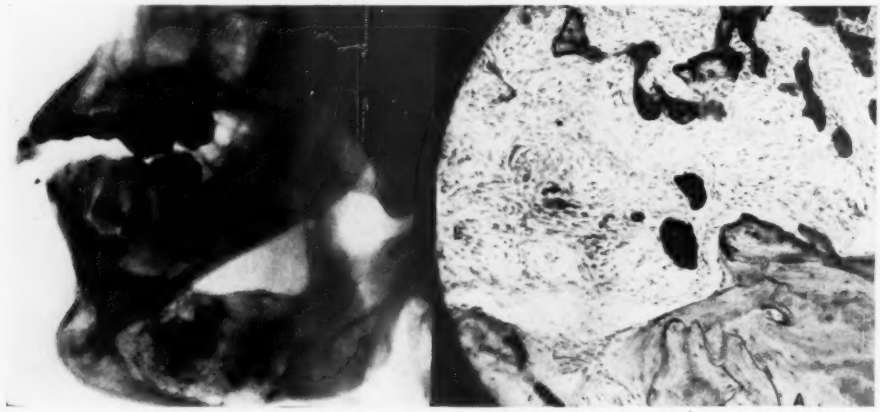

FIG. 23.—(Case 9.) Roentgenogram of the tumor in body of mandible.

FIG. 24.—(Case 9.) Photomicrograph showing (A) Dense tumor; (B) Partly ossified tumor.

of its extent were fine irregular bony trabeculae which stained deeply with hematoxylin. In other regions there were islands of osteoid tissue staining faintly with eosin. Giant cells and hematopoietic cells were absent. Diagnosis: Fibrous osteoma.

The patient recovered uneventfully. 618 roentgen units were then given over the involved area and five months subsequently there had been no change in size of the bone.

Case 10.—J. A., female, age 31, had had a tumor of the inferior border of the right mandible that had been present for the past 18 years. Examination was essentially nega-

tive with the exception of the scars from an old osteomyelitis of the right tibia and a smooth, hard, small, rounded tumor protruding from the inferior border of the right mandible.

Roentgenologic examination (Fig. 25) revealed a small dense semicircular shadow projecting downward from the lower border of the cortex of the body of the mandible opposite the first molar tooth.

The tumor was chiseled off under local anesthesia. It was found to consist of a dense bone with no plane of separation between it and the cortex of the mandible.

Microscopic examination of a section through the entire tumor showed a small piece of mandibular cortex included with the base of the tumor. Lamina of mature bone that were continuous with the cortex bulged outward to form the tumor base. The marrow spaces of this cortical bone were small and contained a few spindle cells but no fatty or hematopoietic bone marrow. Peripheral to this was a zone of younger and more

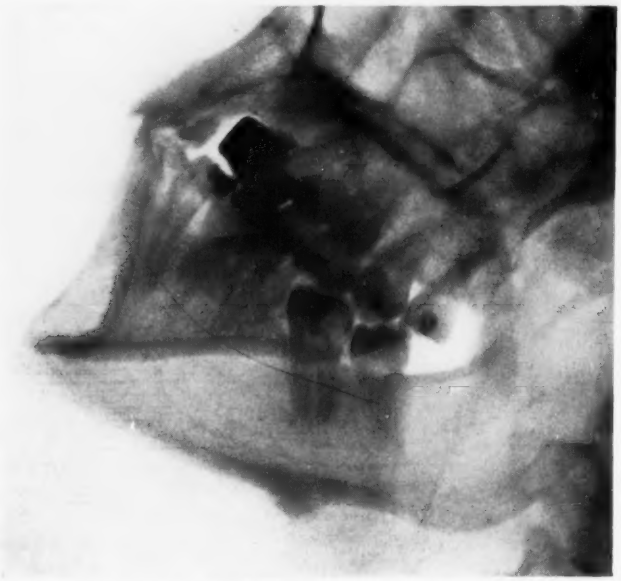

FIG. 25.—(Case 10.) Roentgenogram of the tumor of lower margin of mandible.

irregularly distributed lamina and trabeculae of bone with also small partly fibrous marrow spaces. Between this zone and the cortex was a spongy bone layer with fine trabeculae and large marrow spaces that were partly empty and partly filled with fibrous tissue. The cortex was thin and irregular. In several places osteoclasts were attacking it from the inside. Diagnosis: Fibrous osteoma.

The patient recovered uneventfully and three years later there was no evidence of recurrence.

Case 11.—This was similar to Case 10 and was associated with a fibrous osteoma of the frontal bone.

J. S., age 9, was admitted to the hospital because of a slowly growing bony swelling in the left lateral supra-orbital region of two years' duration, which bulged both anteriorly and into the orbit. Through an incision in the line of the eyebrow the anteriorly protruding portion of tumor was removed. One thousand five-hundred roentgen units were given in six doses during the next three months. Six months later there had been no further growth of tumor, but the portion protruding into the orbit was chiseled away because of the deformity which it produced. Three and one-quarter years after the first admission the patient was readmitted because of a pea sized hard bony swelling of three months' duration at the lower margin of the right mandible opposite the bicuspid tooth. There

had been no further growth of the supra-orbital tumor, although roentgenograms showed slightly increased density of the remaining bone. A roentgenogram showed an oval, even bony shadow protruding from the lower mandibular surface opposite the right bicuspid tooth. At operation six weeks ago it was found to be superficially located and was chiseled off.

Microscopic examination of the half oval shaped section showed it to consist of dense spongy bone with marrow, some of which was fibrous and some fatty and hematopoietic. There was active new bone formation along the surface which was covered by a layer of osteoblasts resembling the cambium layer of the periosteum in infancy.

The occurrence of the lesion in association with an osteoma of the frontal bone is good evidence of its benign neoplastic nature and contradicts the view held by some that it is an osteodystrophy or a hypertrophy. Also, the failure of recurrence of tumor after postoperative roentgen therapy of the unremoved portion of frontal osteoma is a point in favor of this procedure for all incompletely removed fibrous osteomata.

Case 12.—C. F., male, age 50, was admitted with the history that six months previously he had noticed a small lump on the lateral side of the alveolar margin just anterior to the angle of the mandible. He believed that it had enlarged slightly.

Examination was irrelevant except for the left body of the mandible. All the teeth had been removed. In the region previously occupied by the last premolar and first molar teeth the alveolar margin and upper half of the body of the mandible were expanded by a hard painless tumor which protruded about 6 Mm. buccally and 2 Mm. dentally. The overlying mucosa was intact.

A roentgenogram reveals a slight elevation of the alveolar margin of the body of the mandible about 1 cm. forward from its junction with the ramus. The cortical shadow is destroyed. Beneath this in the upper half of the body of the mandible is an irregular area of reduced density. A small irregular area in its center has a density similar to the uninvolved portion of the body of the mandible.

The tumor was exposed through an incision in the overlying mucous membrane and removed. It involved the entire thickness of the mandible and consisted of a dense spongy bone. The patient made an uneventful recovery.

Microscopically the tumor consisted partly of regions of dense bone with fibrous marrow and partly of regions of spongy bone with a marrow that was partly fibrous and partly hematopoietic. The lesion appeared to be stationary and of long standing. Diagnosis: Fibrous osteoma.

C. Fibrous Osteoma of Both Jaws

Case 13.—White, male, age 8, entered the hospital with the history of a swelling in the right maxilla noticed by his parents for three and one-half years. A month before his admission three deciduous teeth at the site of the tumor had been removed and a biopsy taken. Examination was irrelevant aside from the jaws. There was a bony hard enlargement of the entire right maxilla which protruded in the infra-orbital alveolar and palatal regions. No change was observed in the other maxilla or in the mandible. Roentgenologic examination (Fig. 26) showed a dense radio-opaque shadow in the region of the enlarged maxilla and filling out the antrum. There was slight thinning of the shadow of the cortex of the right half of the body of the mandible with slight expansion at the angle of the jaw and an area of circumscribed reduction in density 1 cm. in diameter beneath the permanent premolar tooth.

Under ether anesthesia the mucous membrane along the alveolar margin of the maxilla was incised and a spongy bony mass was thus exposed involving the whole enlarged maxilla and extending into the border of the malar bone. The wall was cut away and the interior of the maxilla curetted out leaving a thin shell. Three permanent teeth were removed. No antrum was present. There was a spherical mass of soft myxomatous tissue about 1 cm. in diameter in the vicinity of the premolar teeth. The remainder of the

tumor consisted of soft spongy bone. No cysts were present. Figure 27 shows the trabeculae of bone and the fibrous tissue filling the marrow spaces. A section of the soft mass showed it to be composed of myxomatous tissue (Fig. 28). No giant cells or

FIG. 26.—(Case 13.) Roentgenogram showing dense tumor of right maxilla, and a beginning tumor in right side of mandible.

mitotic figures were seen. Diagnosis: Fibrous osteoma of maxilla containing one myxomatous area.

Because some of the tumor about the walls was left behind it was decided to administer

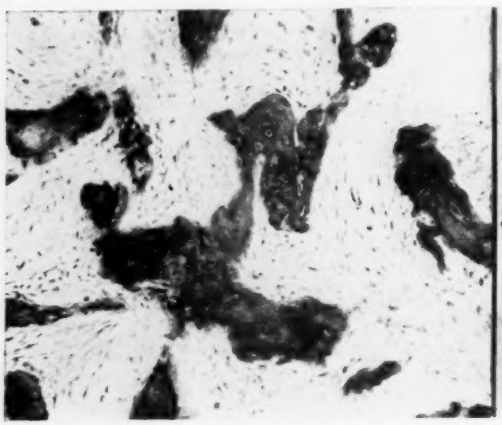

FIG. 27.—(Case 13.) Photomicrograph showing spongy bone with fibrous marrow.

FIG. 28.—(Case 13.) Photomicrograph showing an area of myxomatous degeneration.

roentgen therapy in an endeavor to restrain its further growth. During the next 15 months the patient received 3,883 roentgen units to the maxilla and recent examination six years after operation revealed only slight progression in the form of a pea sized nodule on the anterolateral aspect of the maxilla.

A year and one-half after the operation on the maxilla some enlargement was noted

of the right half of the body of the mandible. During the next two months it was given 824 roentgen units but the overgrowth continued slowly during the next four years and it extended into the right ramus slightly past the midline anteriorly (Fig. 29). A roentgenogram (Fig. 30) showed a marked expansion of the shadow of the entire right half and the mental portion of the left half of the mandible. The cortical shadow was thin

FIG. 29.—(Case 13.) Photograph five years after removal of tumor of right maxilla. The mandible is now the site of tumor formation.

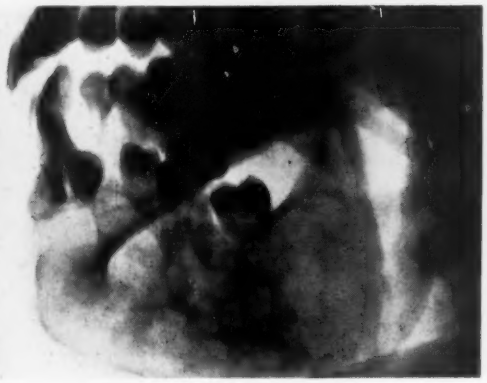

FIG. 30.—(Case 13.) Roentgenogram made at time of photograph shown in Figure 29.

and the interior faint and mottled with two large areas of greatly reduced density along the inferior margin in the premolar to bicuspid region. Operation was performed for removal of the tumor and restoration of normal contour of the mandible. Serum calcium was 10.08 mg. An incision was made along the inferomesial border of the right half of the mandible and the periosteum reflected to expose the lateral and inferior surfaces of the

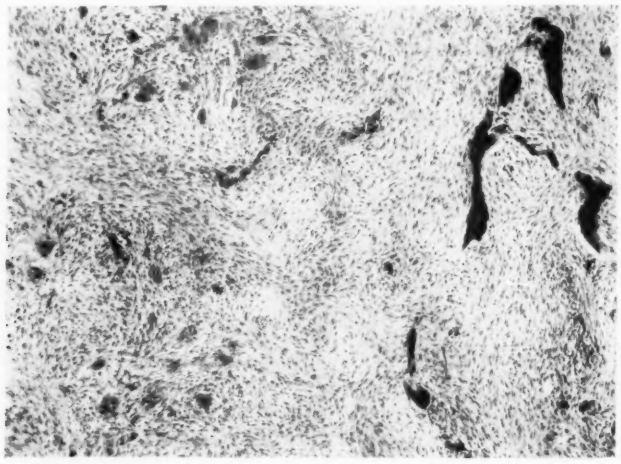

FIG. 31.—(Case 13.) Photomicrograph of the tissue contained in the tumor of the mandible, showing bony and fibrous areas and many giant cells (× 125).

enlarged bone. Approximately two and one-half centimeters of the lateral surface and two centimeters of the under surface of the mandible were chiseled away. The mental nerve was exposed and preserved. There were two large oval areas of soft tissue which upon microscopic examination proved to be composed of myxomatous tissue of a mature type containing areas of fibrous tissue and areas of calcification and bone formation.

Microscopic examination showed the remainder of the tumor to be more or less extensively ossified. The bone was cancellous and the marrow consisted of cellular fibrous tissue. There were scattered areas of fibrous tissue in which there was no ossification but in some places there were clusters of giant cells simulating the picture of benign giant cell tumor (Fig. 31).

Thirteen months after the operation there was practically no further growth of the mandible and the facial configuration had become restored almost to normal.

Discussion.—Osteomata of the membrane bones in general are frequent, and the literature, old and new, is replete with cases, most of which are incompletely reported. The majority are tumors of the cranial vault and walls of the accessory nasal sinuses. Carl O. Weber,[8] in 1856, reported that in a total of 95 cases, 43 were of the jaws and 52 of the skull and remaining bones of the face. Sjoberg[9] reports a total of 19 osteomata of the maxillary sinus in the literature up to 1935 and adds two more cases.

It is a common experience of dentists to encounter small osteomata on the lingual surface of the alveolus of the mandibular bicuspid which necessitate removal because of their interference with dentures. According to Partsch[10] this lesion is often symmetrical and Greve[11] refers to it as symmetrical mandibular tori. Also a small osteoma or hyperostosis, the palatine torus, is not infrequently observed in the posterior midline of the hard palate that is too small to call for surgical removal.

Numerous medical and dental text-books and journals contain brief and incomplete accounts of cases similar to the 13 here reported. Furedi has recently given incomplete descriptions of 14 cases involving maxilla. A considerable number of cases have also been reported in detail. They have been variously designated as osteofibroma, ossifying fibroma, osteoma, fibrous osteoma, exostosis, localized osteitis fibrosa, osteodystrophia fibrosa localizata, localized Paget's disease, "intra-osseous epulis," and hypertrophic localized osteitis. A summary is given of 30 detailed reports by Hildebrand,[12] Gangniere,[13] Hippel,[14] Uyeno,[15] Menzel,[16] Mauclaire and Maurel,[17] Monnier,[18] Montgomery,[19] Moorehead,[20] Kindler,[21] Potts,[22] Konjetzny,[23] Kriegsmann,[24] Renner,[25] Axhausen,[26] and Dechaume.[27] Twenty-four of these tumors began between the ages of eight and 32. The oldest age of onset was 54. Only three of the reported cases were followed more than a year. Seven years was the longest postoperative period of observation. Nineteen occurred in either maxilla and seven in the body of either side of the mandible. One reference was found to a tumor of the maxilla and the mandible on one side in the same patient.

No cases were reported to have undergone sarcomatous change. One lentil sized cyst was reported near an antrum in one tumor, and small cyst like spaces 2 to 5 Mm. in diameter were reported in another. Giant cells in small numbers were described in five, and myxomatous areas in one. Trabeculae of new bone in a mozaic pattern and fibrous marrow spaces characterized all the reports.

A history of trauma was emphasized as an etiologic factor in two cases,

a history of caries of the teeth and extraction in 11, and pharyngeal infection in three. Blood calcium had been analyzed in only one case and it showed a moderate hypocalcemia. A positive statement of the remaining skeleton in ten cases described no other bone pathology.

The first available detailed description of this type of tumor was published by Menzel in 1872. It had been noticed in the mandible at the age of ten and had grown in the next 25 years to the size of a fetal head. It was then removed because of threatened obstruction to the air and food passages. The gross and microscopic diagnosis was a benign osteofibroma.

Many years later the histologic resemblance between these localized tumors and the marrow fibrosis with new bone formation of osteitis fibrosa generalizata (von Recklinghausen's disease) was emphasized by numerous surgeons. From this period up to the time of the discovery by Collip,[28] in 1925, of the parathyroid hormone, and the demonstration of its relationship to osteitis fibrosa generalizata by Jaffe, Bodansky, and Blair,[29] in 1930, these jaw tumors were considered by many to be directly related to von Recklinghausen's disease.

In the cases in this study no abnormalities of blood calcium and phosphorus or of the remaining skeleton have been found. Also cysts have been absent and giant cells infrequent. Although the etiology of these tumors is undetermined there seems to be little indication to relate them to osteitis or osteodystrophia fibrosa generalizata or localizata, and similarly they do not resemble Paget's disease or epulis. It appears that, in a general manner, these tumors have a relationship to membrane preformed bone parallel to the relationship that benign cartilaginous tumors and exostoses have to cartilage preformed bone. This view is substantiated by their tendency to begin in childhood and to grow slowly or not at all in adult life as is the case with cartilaginous exostoses.

A study of the histology of this group of tumors brings out the great variability in the amount of fibrous and osseous tissue. Some tumors are composed of rather mature bone trabeculae with partly fibrosed marrow. Others have islands of fibrous tissue undergoing varying degrees of ossification and calcification. There may also be areas of myxomatous tissue and giant cells. In a few the tumor is chiefly fibrous tissue with small amounts of ossification. The terms fibrous osteoma, osteofibroma, and ossifying fibroma are often used more or less interchangeably. The more mature tumors with extensive ossification are probably better called fibrous osteomata, while those in which fibrous tissue and immature bone predominate justify the terms osteofibroma or ossifying fibromata. Round cell infiltration and other inflammatory changes were, in general, conspicuous by their absence.

Symmetrical osteomata have rarely been described, most of the symmetrical jaw tumors being reported as fibromata of the gums (Perthes,[30] Rosenstein,[31] Koblin[32]).

Treatment.—The treatment of this condition, as detailed in the literature, has been varied. Eleven of the older cases were treated by complete resection, one by partial excision and roentgen therapy, two were biopsied and received

roentgen therapy, and three received no treatment after biopsy. The early treatment by massive resection was very disfiguring and carried a high mortality. In view of the benign nature of the lesion it is no longer justified. Biopsy should certainly be performed as soon as the tumor is noticed, since it is, usually, otherwise impossible to establish its benign nature definitely. The decision not to interfere with a tumor may be justified in some instances in view of the very slow rate of growth and slight disfigurement. The majority of authors agree, however, that the tumors should be operatively removed as thoroughly as possible without too great destruction of the jaw bone. It must be emphasized, however, that one operation does not necessarily cure the patient. The condition may recur and require further partial or total resection.

Irradiation has not been generally used in these tumors of the jaw. Six of the cases here reported with incompletely excised tumors received roentgen therapy. One was markedly, and another moderately, benefited, although the process continued slowly in the other jaw despite irradiation, and four were too recently treated to warrant an expression of opinion. In one recent case a frontal bone osteoma that had been partly removed three years previously and then treated by roentgen therapy has been held in check. The experience in treatment of these patients makes it appear that roentgen therapy is beneficial in controlling portions of the tumor not removed at operation. Authors report benefit from radium treatment but also point out the danger of bone necrosis and slough following its use.

SUMMARY.—Thirteen cases of fibrous osteoma of the jaws are reported and the pathology of two other recorded cases discussed. The bone was formed by the process of fibrous or membranous ossification, cartilage being seen in a minute trace in only one case. In 12 cases the tumor consisted largely of cancellous bone and fibrous marrow. In three it consisted largely of fibrous tissue in varying degrees of maturation, and ossification was proceeding slowly. There was also myxomatous tissue present in three cases and occasional small islands rich in giant cells in two. Microscopic signs of inflammation were rarely present.

CONCLUSIONS

In general, the tumors are slowly growing, and when starting in childhood tend to become stationary in adult life. No case has been recorded which has become malignant. Blood calcium and phosphorus were determined in four cases and found to be normal. The lesion appears to be a true neoplasm and not a form of osteitis fibrosa, hyperostosis or chronic inflammation. The treatment consists in complete operative removal when the lesion is small and circumscribed. But in cases with diffuse involvement of the bone the operation should, as a rule, be limited to partial removal in order to avoid defects in the jaws and extensive disfigurement. Repeated operations may be necessary. Roentgen therapy was found to retard growth of the unresected portion of tumor for long periods in two cases.

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FRACTURE OF THE FEMUR IN CHILDREN*

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IT IS the universal experience that the prognosis is excellent in uncomplicated fractures of the femur in children. This fact probably accounts for the variety of the treatments which are recommended. Prey and Foster,[2] after a study of all the fractures of the femoral shaft that occurred in Denver, find that the greatest number of satisfactory results were obtained by the use of the Bryant overhead traction in infants and by the use of Russell's[15] balanced suspension in older children.

Eikenbary and Lecocq[3] report 100 per cent perfect functional results with the Russell method in 40 children, the oldest of whom was 18 years and the youngest 19 months. Kellogg Speed[4] recommends Bryant's suspension in children under seven and suspension traction in a Thomas splint in those over seven. Firor[5] concludes that in all children the spica case gives results as good as those obtained by the overhead traction.

West[6] finds his best results from the use of Bryant's suspension for children under three years and by wire traction incorporated in the double spica case for those between three and twelve. Steel and Grossman[7] recommend Bryant suspension in children under five and plating followed by the leg and body encasement in older children.

Such variety of authoritative opinions has created the impression that in fractures of the femur in children good results will be obtained regardless of the method of treatment. The impression is true but true only when the surgeons who are adequately trained and equipped are following procedures with which they are familiar.

The most important consideration in any fracture of a child's bones is that the growth of these bones is still active. Following such a fracture there is a rapid deposit and ossification of callus followed by an equally prompt absorption of excess callus and rectification of deformity usually leading to a result without deformity or impairment of function. This is in accord with Wolff's law, which states: "The internal and external configuration of bone is adapted to the function it performs; that bony deformity after fracture and the visible prominences caused by callus tend to lessen or entirely disappear, the sharp angles round off, and new trabeculae form along the lines of stress." It should be carefully noted, however, that while this improves the appearance at the site of any deformity it does not restore normal axes nor remedy other ill effects of malunions. It is not the part of good treatment to depend upon spontaneous correction of shortening, angulation, and atrophy, as one occasionally still sees deformity and shortening with disability.

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In addition to this remodeling at the site of the fracture, there occurs an overgrowth of bone in the longitudinal direction which often compensates for any shortening. The most careful study of this phenomenon of compensatory lengthening has been made by David,[8] and Bisgard more recently. By detailed examinations he was able to make the following report on 62 children whose fractured femurs showed shortening on discharge from treatment (Table I).

TABLE I

Cases	Shortening	Reduced to Normal	Incomplete
1	2 ins.		1 to 1 in. in 19 mos.
7	1¼ ins.		2 to ¾ in. in 5 mos.
			5 to ½ in. in 7 mos.
4	11 ins.	4 in 15 mos.	
10	¾ in.	3 in 9 mos.	3 to ½ in. in 5 mos.
			4 to ¼ in. in 8 mos.
3	⅝ in.	3 in 3 mos.	
14	½ in.	8 in 5 mos.	6 to ¼ in. in 4 mos.
10	⅜ in.	7 in 5 mos.	1 to ¼ in. in 5 mos.
			2 to ⅛ in. in 2 mos.
11	¼ in.	11 in 3 mos.	
2	⅛ in.	2 in 2 mos.	
62		38	24

In our experience, shortening up to one-half inch need cause no grave concern, providing the alignment is good but our aim now is—no shortening. In a recent survey of an industrial group of 2,000 men, we found 10 per cent with inequality in the length of the legs. Those who had a difference of one-half inch or less were not conscious of the inequality. In other words, inequality up to one-half inch caused no functional disability nor any postural or locomotive change sufficient to attract the attention of other persons. A further interesting observation in this group was that none gave the history of any injury to either leg. Spontaneous inequality therefore occurs apparently fairly frequently. Philosophic consideration might raise the question whether any inequalities noted after fractures are necessarily to be looked upon as being caused by those fractures.

Correct alignment is unquestionably the most important requirement for good results in so far as equality in the length of the legs is concerned. On the other hand, angulation permitting union in a bowed position is to be looked upon as a major failure. Of equal importance with good alignment is the avoidance of muscular atrophy. While insufficient as a rule to interfere with the ordinary use of the limbs, its bad psychic effect upon children is perhaps as great as a lameness produced by gross inequality in the length of the limbs.

Kellogg Speed[4] states that in children between the ages of two and four years callus is normally fully formed in two weeks' time and that in children under 12 years of age, callus is fully formed within three to four weeks. This is important in any consideration of open reduction methods of treat-

ment for the time when such operative interference should be undertaken is considered of great importance.

Goetz and Brackertz's[9] experimental work demonstrates there is definite delay in callus formation after open reduction either with or without fixation but that it is not so marked if operation is delayed seven to ten days. Should open reduction in childhood be delayed for seven to ten days, it would be necessary to disrupt almost fully formed callus before any reduction could be accomplished.

Open Reductions.—Operative intervention in fracture of the femur in a child is a very hazardous undertaking in the management of such fractures. Aside from the possibilities of infection with subsequent osteomyelitis, operation involves scarring of the tissues, at times nerve injuries, longer fixation and delay in the movements of the leg—all inviting musculature atrophy. There is also an apparent delay in solid union in the presence of metal plates. Several surgeons have reported bowing at the site of the fracture following the removal of Lane plates.

Cole[10] reports one patient in whom an intermedullary plate had been used and the child returned in two months' time with a refracture at the site of the original fracture. It was also his experience that abnormal bowing of the shaft served as one of the greatest factors of deformity and disability. In his series of 31 cases, it occurred only in those operated upon.

Conwell[11] found no open reduction necessary in his series of 86 cases and states that operative methods should be used only as a last resort. There undoubtedly is an occasional death definitely attributable to the operation.

Burdick and Siris[1] reported 268 cases in which operative treatment was resorted to 19 times including bone plating in six cases; open reduction without internal fixation in six cases; calipers in five cases; and Steinman's pins in two cases. They report that an appreciable lengthening of the femur beyond normal was frequently present when operative intervention had been resorted to and that this lengthening was not due to overcorrection except in two instances in which calipers had been inserted, and conclude that open reduction is rarely indicated inasmuch as skeletal traction will invariably correct any marked deformity.

In a series of 30 cases occurring in the Cincinnati General Hospital, L. B. Johnston[12] found open reduction unnecessary. In his opinion, it might be necessary in an occasional fracture of the lower third with the distal fragments in poor position and demonstrated to be irreducible by trial of closed methods.

Orr[13] states that after knowing the restorative power of the injured femur in the young, operation will be rarely resorted to in order to obtain good functional results. This opinion was drawn from his experience in the case of a boy 11 years old who had a transverse fracture of the upper third of the right femur. In a Hodgen's splint, with very little traction, two inches' overlapping resulted in two weeks. In a better splint with increased traction, it was impossible to overcome the entire shortening and the fracture united

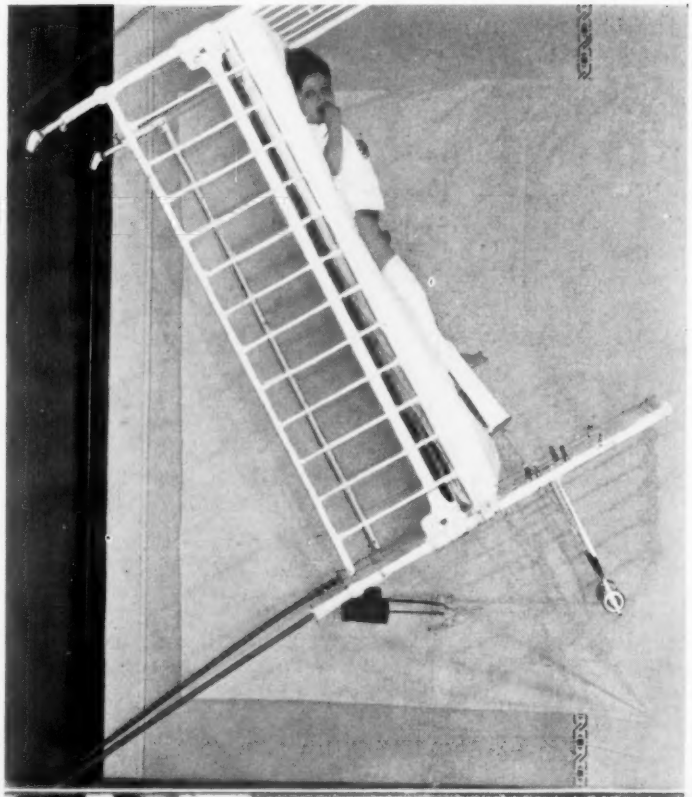

Fig. 1.—Plan by which direct extension is placed in fracture of femur, using the weight of the body as counter-extension.

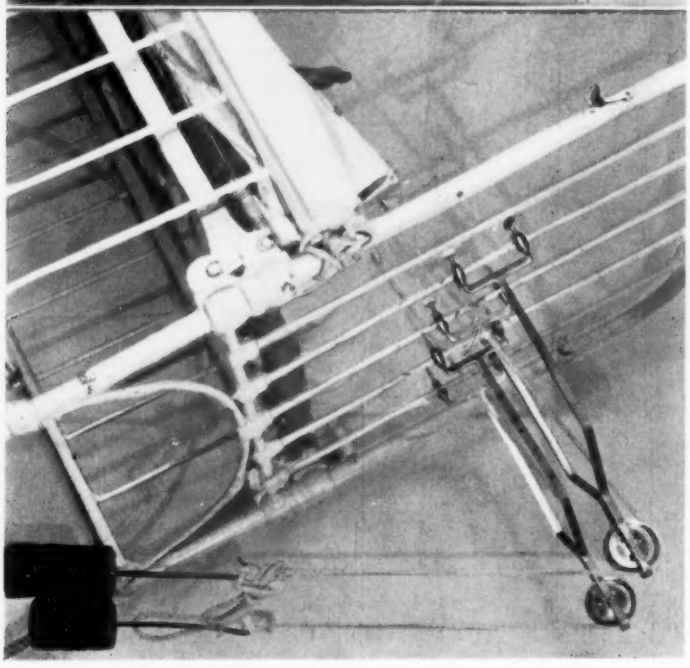

Fig. 2.—Details of traction.

with one inch shortening. Operation was considered but nature was first permitted to function. In eight months' time, there remained only one-half inch shortening and function was perfect.

Speed states that in cases where a complete reduction cannot be obtained by closed methods surgeons must be satisfied with the best reductions possible provided it will result in good function. If there is no possibility of good function open reduction is indicated. With this, I agree.

In general, operations are to be avoided. When operations are contemplated the dangers should be given more serious consideration than the apparent indications, for as Eikenbary and Lecocq state, "Many children have been crippled when the surgeon in his anxiety to get a beautiful X-ray result has resorted to open reduction."

Plaster Encasement.—Since Cushing, in 1898, began the use of spica plaster encasements their use has been common. They may be used with or without extension. Experience has been varied as to their value.

Firor's[5] study of fractured femurs treated in Johns Hopkins Hospital included 102 cases treated by immediate reduction and application of the spica encasement. He reached the conclusion that such immobilization does not give satisfactory results in patients over 14 years of age but in children gives as good results as those obtained by overhead extension.

Poulsen[14] recommends the use of the plaster spica which is applied while traction is being exerted on the leg and the hip is flexed to a right angle. With this method he has been able to obtain good results in some cases in which overhead extension has failed to reduce the deformity.

Johnston, on the other hand, found in 30 cases that in transverse fractures in children between five and ten, the double plaster spica gave the most unsatisfactory results. His experience was that the patients were most difficult to handle and fluoroscope; that the fragments often slip; and if malposition occurred it might not be discovered for two or three days, when open reduction is difficult. Kellogg Speed also found plaster encasements were inadequate to maintain extension and alignment of the fragments, which corresponds with our own experience.

With continuous extension, however, Burdick and Siris report satisfactory results in older children. Conwell[11] also found that better results were obtained in the older children when a plaster encasement plus extension was used. The preponderance of opinion is that the encasement is more suitable for the older child. In the younger child it is almost impossible to get a form of splint or case which can be kept from being grossly soiled by excreta. Even in the older children, there are often serious effects upon the joints and muscle wasting from the application of a plaster encasement with delay in the return to normal function. Its use has been stimulated by the inadequacy of the Bryant extension for the older child. In my service it is only used after union has occurred and where the transportation of the patient is desirable.

Burdick and Siris in summarizing their personal experience adequately

express the general opinion regarding the use of splints. "With the Hodgen or Thomas splint, children would toss and tilt the splint to the sides; the rings were either too large or too small; occasionally the ring became moist or the skin traction would slowly slip down over the heel and malleoli producing a sloughing of the skin unless carefully guarded against. In cases where the knee was flexed and the extension was made only on the thigh the constant wriggling of the patient who only occasionally cooperated would frequently tear off the adhesive traction tapes. The method requires constant vigilance. The advantages claimed that active and passive motion can be begun at the onset with consequent early functional recoveries does not warrant their use except perhaps in compound fractures with ulceration or severe trauma to adjacent tissues where the administration of an anesthetic is contraindicated or where skeletal traction is to be employed."

There is almost unanimous agreement that for the younger child the Bryant, one or both legs, vertical suspension treatment has given the most satisfactory results. It can be carried out at home because of its simplicity and the ease of nursing care. It permits frequent inspection, actively maintains muscle tone, and permits return to normal function in a shorter period of time than any other treatment.

Such suspension is limited roughly to children under the age of eight. I use it only on babies. The older child's heavier weight will frequently tear off the extension tapes permitting sagging of the fragments and requiring frequent reapplication.

The Russell[15] balanced traction method is used widely and successfully in the older child. Prey and Foster, and Eikenbary and Lecocq prefer it for all ages. As Russell himself and Lee and Veal[16] point out, the method requires meticulous attention to details of the Russell suspension. It requires frequent adjustment and must be personally inspected not less than twice daily by the surgeon who is thoroughly conversant with its requirements, if satisfactory results are to be obtained. My experience was most satisfactory.

Because of these limitations of the suspension methods, the use of splints, plaster encasements, and open reductions has found favor in the older age groups. With experience, these latter methods have in turn been extended to include the younger age groups. It is quite obvious from the few references quoted that these methods contain greater hazards and limitations than the suspension method, except in a few exceptionally experienced hands, and I think they will agree with me that this 45° extension has less adjustment to make and is almost fool proof.

My own experience parallels that of the surgeons reviewed in this survey. We have seen merit in every method and in certain cases have found each method ideally suited to meet special indications. For the routine care of all cases, however, each method has its limitations and hazards.

To avoid these limitations we have recently adopted the scheme of placing extension upon both legs and thighs by means of adhesive plaster and elevating the foot of the bed to a height where the bed stands approximately at a 45°

angle with the floor. The idea is simply that of a Buck's extension with the added feature of high elevation of the foot of the bed. Boards placed under the mattress and spring prevent sagging of the bed. Pillows should not be allowed as they tend to prevent extension. Its traction effects are identical with those of Bryant's extension with the advantage that it can be used in older children up to the size of the average 12 year old child. I have used weights over pulleys for extension but feel reasonably certain that results would be quite satisfactory if the extension straps were simply fastened to the elevated end of the bed. In practice, the weights do enable us to regulate the amount of extension and we usually use more weight on the injured leg than on the uninjured one. Having the head hang low does not seem to annoy the children, and to my surprise they eat up hill without any difficulty.

Nursing care and examinations are simplified; active tone of the musculature is maintained; after a week or two, the children roll about and partially sit up. The use of the bed pan does not seem to cause any displacement as the extension is always present.

Our results have been so satisfactory that we feel justified in reporting the 11 cases in which we have used this method (Table II).

TABLE II

Cases	Location	Age	Days	Length
1.	Middle third....	11	39	Equal
2.	Lower third.....	7	59	Equal
3.	Middle third....	6	57	0.1 in. shortening
4.	Upper third.....	3	50	Equal
5.	Middle third....	3	58	Equal
6.	Junction upper.. and middle third	3	49	Equal
7.	Junction upper and middle third	3	50	Equal
8.	Middle third....	3	46	Equal
9.	Middle third....	4	39	0.25 in. shortening
10.	Middle third....	5½	50	Equal
11.	Upper third.....	9	39	Equal

In a follow up made by Dr. Wm. Decherney, he reports the following—no angulation or deformity in any of the cases; one patient has one-quarter of an inch lengthening; the remainder show equal measurements.

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DISCUSSION.—DR. CALVIN M. SMYTH, JR. (Philadelphia), Doctor Dorrance has referred to the late Dr. John Ashhurst who said that he had never seen a fracture of the shaft of the femur without some shortening. It might not be amiss at this time to quote a statement of the late Dr. Astley P. C. Ashhurst who, in discussing the same subject before this Academy, said that he had never seen a case of fracture of the shaft of the femur in a child in which a good result was not obtained, regardless of the treatment applied. I think that we can all subscribe to this statement. The plan of treatment described by Doctor Dorrance would appear to be identical, at least in principle, with what is popularly known as the British method, that is to say, a Thomas splint tied to the top of a Balkan frame with the limb in abduction and the foot of the bed elevated in order to obtain counter traction by the weight of the body. If we accept the idea that fractures of the shaft of the femur in children are going to get well regardless of the treatment employed, it becomes obvious that each surgeon should use that method which in his case gives the greatest satisfaction. It is my own practice to treat fractures of the shaft of the femur in children by overhead suspension with the Bryant frame. The extension is always applied to both legs and I did not know, until Doctor Dorrance referred to it, that anyone still employed traction on one leg only. In older children we have had excellent results with the Russell method of traction, which is very comfortable but which requires constant supervision to prevent the child from sliding down in bed. This can be overcome by anchoring the shoulders to the head of the bed by means of a canvas vest and shoulder straps. I have employed open reduction in children for only one condition, namely, interposition of soft parts, where, if open reduction is not made, union will not take place. I believe that many fractures of the shaft of the femur in children are operated upon entirely without justification. Doctor Pfeiffer will recall a case a number of years ago in which a competent surgeon had treated a fracture of the shaft in a child three years old and obtained an excellent result with one-half inch overriding. Union was solid but the fragments were not in end-to-end apposition, although the alignment was excellent. Unfortunately there was a trained nurse in the family, which always complicates matters. She saw the roentgenograms and, with the layman's true horror of a roentgenographic deformity, she immediately removed the child from the hospital, took it to a surgeon whose work was concerned not primarily with recent injuries but with late results and chronic deformities of the bone. He proceeded to perform an open operation, broke up the union and put in a plate. This sort of practice might well be termed malpractice.

I have enjoyed hearing Doctor Dorrance's paper tonight although I must say that my sympathies have gone out to the child who has remained so patiently for two hours or more in what looks to me like a very uncomfortable position. I would like to repeat that the way for surgeons to treat fractures of the femur in children is by the method which he finds most satisfactory in his own hands. If this method has been so proven in Doctor Dorrance's hands he will doubtless continue to use it.

GANGLIA AND SYNOVIAL CYSTS

THEIR PATHOGENESIS AND TREATMENT

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Little attention has been given to the subject of ganglia and synovial cysts. The causative factors still remain obscure. Several theories have been evolved, none of which adequately explains the several varieties that are seen. Two groups of cases will be discussed in this paper.

Pathogenesis.—Whether ganglia and synovial cysts are slightly different modifications of the same condition has never been determined. Clinical distinction between the two is often impossible and therefore they are discussed together.

Eller, in 1746, concluded that ganglia resulted from rupture of a tendon sheath with extravasation of the synovial fluid into the tissues forming cysts. Voght suggested that they arose from tendon sheaths, joints and bursae. Gosselin, in 1852, expressed the opinion that they developed from crypts in the synovial membrane and Virchow thought that they arose from tissue clefts. Ledderhose[5 & 7] probably was the first to advocate the theory that they were formed from degeneration of connective tissue in the periarticular areas. He called them cystomata. It is difficult to conceive how degeneration of connective tissue only in specified areas such as the neighborhood of joints can form cysts and not take place elsewhere. It, therefore, is logical to assume an underlying factor, possibly associated with faulty development of periarticular tissue which may antedate this condition.

Harrison,[6] studying the origin of embryologic connective tissue, concluded that it developed from a gelatinous material in which fibrils were gradually elaborated into delicate net like structure and then into long fibers which were typical of connective tissue. A comparison is drawn of a plasma clot forming fibrin, or of inter- rather than intracellular origin. These early mesenchymal cells are modified to form fibroblasts and other types of connective tissue characteristic of the adult.

Beginning in gelatinous material in which fibrils are elaborated to form connective tissue which further differentiates into synovial membrane, tendons and tendon sheaths,[4] it seems probable that arrests in development might occur and, as growth proceeds, synovial cysts and ganglia could arise. The original faulty development of the tissue in the periarticular areas, and the more extensive modifications necessarily taking place in regions such as the wrist, may account for their greater frequency in this location.

This theory is not new, but seems first to have been expressed by Floderus[1] and supported by Küttner and Hertel, who regard the process as not one of

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degeneration but colliquation causing cavity formation, and in some way physiologic. Cavity formation is a biologic property of synovial tissue, bursae being formed in this manner, although in ganglia and synovial cysts, the bursal functional aim is absent.

The development of ganglia from remnants of ectopic synovial tissue and from highly differentiated embryologic arrests would account for all the varieties that are seen. It should be added that all cysts that are called ganglia do not belong to embryologic abnormalities. The hygromata of bursae are very similar in pathogenesis and morphology, but differ from ganglia in that they have useful function.

FIG. 1.—Ganglion of the dorsum of the left middle finger. Excision under local anesthesia. Fibrous tissue sac intimately connected to the tendon sheath. (Knickerbocker Hospital.)

It is now commonly accepted among pathologists that these cystomata are lined with mesothelium. Its character seems to be the same, whether ganglia, synovial cysts or bursae (Figs. 4, 5 and 7). Wood[10] states that the lining is made up of long flat cells that do not form tessellated pavement linings which can be stained with silver nitrate like those of serous membranes such as pleura. Küttner says that it cannot be true endothelium since there is no borderline between the lining and the deeper cell layer.

At times the blood vessels in the neighborhood of ganglia show changes in the intima and the musculature which may be so pronounced as to cause obliteration of the lumen. At times there is perivascular round cell infiltration which would tend to indicate inflammatory changes. These findings, however, are not constant.[2]

The contents of cystomata are insoluble in water. Sometimes the reaction is that of pseudomucin and sometimes colloid. Detritus, cellular elements, giant cells and fat droplets may be found.[3] The fluid is usually a thick,

sticky and viscid substance, grayish in color, but at times it is thin, amber colored, opaque and flows as freely as water.

Some observers have inoculated the contents into animals and have been able to show the presence of follicular lesions suggesting a tuberculous origin of these cysts.[8] Plisson[9] believes that only about 2 per cent are tuberculous in origin. In one group of 23 cases from the records of New York Hospital, up to 1932, 13 show positive evidence of tuberculosis on pathologic examination, three were suggestive and seven showed a chronic inflammatory process with no evidence of a tuberculous lesion.

There is little evidence to support the contention that trauma plays a part in the etiology of cystomata.

FIG. 2.—Small irregular mass in the region of the peroneus longus, right ankle, for ten years. Gradually but slowly getting larger. Diagnosis: Ganglion. Operation under general anesthesia. Mass not encapsulated and consisted of dense fibrous tissue blending into the surrounding connective tissue. Many small lakes of venous blood giving it a dark color. Pathologic Report: Fibrous hemangioma. Eighteen months later, no recurrence. Function of the parts excellent. (Knickerbocker Hospital.)

Clinical Findings.—With no sharp line of demarcation between them, the cases can be classified into two general groups. Twenty-one cases from the records of Knickerbocker and New York Hospitals fall into the group of simple cystomata. Except for the presence of the cyst, they have few clinical symptoms to distinguish them. The age limit shows wide variation: The youngest in this series was four years and the oldest 67 years, with the largest number appearing in the third decade. The duration of the cyst varied from six months to two years. The patients sought treatment because of the unsightly appearance, and a few because of the fear of malignancy. Two patients experienced slight pain on movement of the parts. One was tender on pressure and none in this group had limitation of motion. One developed

at the site of an incised wound two years after injury. It would be difficult to conclude that this was the result of the original trauma.

Cystomata have been described in the neighborhood of all freely movable joints, but are most frequently present in the region of the wrists. The ratio of males to females, as noted by some observers, is one to three. In this group there were seven males and 14 females, a ratio of one to two. Twelve occurred on the left wrist and eight on the right. One was present on the dorsum of the first interphalangeal joint of the left middle finger. The occupations varied from a child, age four, to an operator of machines, and seemed to have no bearing on the etiology.

Illustrative Case Reports in Instances of Simple Cystoma

Case 1.—No. 55044. New York Hospital. Male, age 51. Occupation, conductor. February 10, 1934. C. C. A small cyst had been present on the back of the right wrist for 18 months. It was broken on two different occasions by a sharp blow with a book and on each occasion the cyst recurred shortly thereafter. Examination revealed a soft fluctuant cyst on the dorsum of the right wrist. No tenderness, no pain and no limitation of motion. Operation.—February 13, 1934. Under local anesthesia. There was a thick fibrous bulging of the tendon sheaths which extended downward between the tendons. All involved tissue excised.

Pathologic Report.—Very dense layer of fibrous tissue resembling tendon with hemorrhage into the tissue. Wall of sac found on the surface of tendon or ligament indicates the usual type of inflammation of bursal or joint cavity.

Case 2.—No. 74940. August 29, 1934. New York Hospital. Male, age 63. Occupation, printer. C. C. Swelling on the under side of the right wrist, six months' duration. No history of trauma. No pain and no limitation of motion. Examination reveals a small, nontender, fluctuant mass present on the volar surface of the right wrist. Operation.—September 5, 1934. Under local anesthesia, a transverse incision was made over the site. The cyst freed to a narrow base and seemed to be connected to the joint capsule. Diagnosis: Ganglion. No pathologic report.

Case 3.—No. 26. Knickerbocker Hospital. November 5, 1935. Colored male, age 4. Three weeks ago a lump appeared on the volar surface of the left wrist. No history of trauma. There is no pain and no limitation of motion. Examination.—There is a soft cystic swelling on the radial side, volar aspect of the left wrist. No redness, no increased heat and no tenderness. Diagnosis: Ganglion. Observation advised. The patient returned to the hospital six weeks later because of a rapid increase in the size of the cyst. No other signs or symptoms. Examination the same as previously except that the cyst has increased in size about five times. Operation—January 7, 1936. Under general anesthesia a linear incision was made over the cyst. It was freed from the surrounding tissue, the pedicle extending down to the joint capsule and opening into the joint. At this point it was ligated and cut.

Pathologic Report.—No mesothelium. The tissue consists of wavy bands of connective tissue.

Follow Up.—July 7, 1936. Reveals some irregularity of the base of the pisiform bone at the site of the original lesion. No evidence of recurrence. No interference with function.

Case 4.—No. 10351. Knickerbocker Hospital. Female, age 48. Occupation, housewife. October 11, 1935. C. C. A small lump appeared on the dorsum of the left middle finger three months previously. She states that she has had the same kind of a lump on the other fingers but they have spontaneously disappeared. Roentgenogram of the fingers reveals no evidence of arthritis. There is no pain, and no interference with function.

The mass varies in size without relation to time. Examination.—The mass is soft and fluctuant, nontender, and moves slightly on flexion and extension of the finger but does not interfere with motion. Diagnosis: Ganglion. Operation.—November 5, 1935. Under local anesthesia, the cyst was isolated and excised. It had a pedicle attached to but which did not open into the tendon sheath.

Pathologic Report.—Wavy elastic tissue with round cell infiltration. No evidence of mesothelium.

This case had lipiodol injected into the cyst for roentgenologic study, which may have altered the pathologic findings.

FIG. 3*a*.—Schematic drawing of a large cyst on the dorsum of the left hand in a right handed barber. Duration, three years. No pain or redness, no increased heat or limitation of motion. Distal portion enlarges some on extension of the fingers. Diagnosis: Ganglion of the dorsum of the left hand. After aspiration, 1 cc. of 5 per cent Sodium morrhuate was injected on three different occasions without change or improvement. Again aspirated and 1 cc. of modified Carnoy's solution injected. There was sudden intense pain in the hand and forearm radiating to the roots of the brachial plexus in the neck. Accompanying this was pronounced edema of the hand. The hand and arm were splinted, the pain subsided gradually and completely abated in three hours. The edema persisted for about one week. (Knickerbocker Hospital.)

FIG. 3*b*.—This shows the result six months later. Now, 22 months later, there is no evidence of recurrence and the function of the parts is normal. A small ganglion has developed on the volar surface of the same wrist. (Knickerbocker Hospital.)

Case 5.—No. 92286. New York Hospital. March 16, 1935. Female, age 28. Occupation, social work. C. C. A painless soft swelling appeared on the dorsum of the right wrist eight months previously. It has gradually increased in size. No pain and no interference with function. Examination.—A soft nontender, fluctuant mass, about 3 cm. in diameter is present on the dorsum of the right wrist. No limitation of motion. Operation.—January 7, 1935. Under local anesthesia, a linear incision was made over the

cyst. The sac was isolated with a pedicle which was attached to the medial side of the common extensor tendon.

Pathologic Report.—The tissue is fibrous and is a structure similar to tendon. In some places there is sac formation lined with very low mesothelium.

In a second group, comprising 23 cases, from the records of the New York Hospital, there were present, in addition to the cyst, signs of further involvement of the tissues as indicated by the frequency of pain and limitation of motion. With the exception of one case, this latter sign was present in all the cases of this group. The degree of limitation varied, at times so slight as not to be obvious to the patient and at other times rather pronounced. The clinical history in all was very similar as well as the other findings on physical examination. A "doughy feel" or crepitus of "rice bodies" has been described as characteristic of a tuberculous process. "Rice bodies" can be present without evidence of tuberculosis (Fig. 6). In this group no such clinical sign was noted. Yet a few presented a rather advanced tuberculous process when the tissue was examined. Furthermore, some of the structures had been practically destroyed. Therefore it is important to state that the examiner should not wait for these two signs before a clinical diagnosis of tuberculosis is made and radical measures instituted.

Illustrative Case Reports of Group II

Case 1.—No. 264787. New York Hospital. American, male, age 41. Occupation, messenger. January 3, 1926. C. C. A small lump suddenly appeared on the back of the left wrist one year ago. No history of trauma. There has been a gradual increase in size with no pain and no limitation of motion.

History: Gonorrhea six times. General physical examination negative. On the dorsum of the left wrist, in the midcarpal region, there is a soft fluctuant swelling about the size of a large walnut. It moves freely beneath the skin but is attached to the deeper structures. It moves some with extension of the fingers. No tenderness and no limitation of motion. Diagnosis: Ganglion. Operation.—January 5, 1926. A longitudinal incision was made over the mass, which was really two masses, extending forward over the metacarpals. There was a definite capsule connected to the tendon sheaths. The masses were opened and a flaky, purulent material was evacuated. By sharp dissection an attempt was made to remove all the involved tissue from the tendon sheaths, without complete success. Incision closed without drainage. Healing by primary union.

Pathologic Report. The wall is fibrous and lined with granulomatous tissue which occludes the vessels. Diagnosis: Granuloma of luetic or tuberculous origin.

Case 2.—No. 290149. New York Hospital. American, female, age 53. Occupation, housewife. December 19, 1929. C. C. Swelling of the volar surface of the right wrist and pain in the fingers of the right hand for one year. She is unable to extend the middle and ring fingers. The swelling has gradually increased in size with a very rapid growth in the last month. Examination.—On the volar aspect of the right wrist there is a tense cystic swelling which extends above and below the volar ligament. It measures about three by one and one-half inches. There is slight tenderness with no redness or heat. The fingers are fixed in semiflexion. Roentgenologic examination negative. Tuberculin test faintly positive. Diagnosis: Ganglion. Operation.—December 10, 1929. A linear incision was made over the mass. Just beneath the skin was a large multiloculated mass which extended in and around the tendons and involved the tendon sheaths. It was filled with a thin yellow fluid and "rice bodies." By sharp dissection the involved tissue was removed. Incision closed without drainage. Hand splinted in extension.

Pathologic Report.—The tissue is thick and inflammatory with some necrosis. Numerous tubercles are present with secondary fibrosis. Diagnosis: Tuberculous ganglion.

Case 3.—No. 297089. New York Hospital. January 20, 1931. South American, male, age 22. Occupation, bus boy. C. C. Seven months ago he fell, landing on the outstretched palm of the right hand. Following this he noticed a small swelling associated with pain, on the back of the right wrist. Since then the swelling has gradually increased in size but the pain has ceased. There is slight limitation of motion of the wrist. Examination.—There is a large, soft, fluctuant mass on the dorsum of the right wrist with no redness or tenderness. Some limitation of extension and flexion of the wrist. Diagnosis: Ganglion. Operation.—January 21, 1931. A linear incision was made over the mass. A large cyst presented which contained necrotic material. The process involved the sheaths of all the tendons in the wrist. The involved tissue was removed by sharp dissection. Incision closed without drainage.

Pathologic Report.—There are numerous white areas in the wall. Dense fibrous tissue is present which is infiltrated with lymphocytes. There are many giant cells with tubercle formation. Diagnosis: Tuberculous tenosynovitis.

FIG. 4.—Presumably a synovial cyst largely denuded. There are a few scattered cells in the glairy contents. (S-34-96, Hist. No. 4228.)

FIG. 5.—Ganglion. The lining cells are quite evident in places. (S-34-2170, Hist. No. 77898.)

Patient readmitted June 4, 1931, with recurrence of the mass at the same site, increased limitation of motion and pus discharging from a sinus. Operation.—June 5, 1931. By sharp dissection the involved tissue was removed. Skin closed without drainage.

Case 4.—No. 277164. New York Hospital. January 2, 1928. Hungarian Jewish male, age 57. Occupation, operator of machines. C. C. A small round swelling developed on the back of the left wrist 13 months previously. It has not changed in size. No history of trauma. No pain except on making a fist. Left hand seems weak and therefore uses it less than the right. History of osteomyelitis 25 years previously, type unknown. Hydrocele three years ago.

Examination.—A semisolid mass about one by two inches in diameter is present on the dorsum of the left wrist and is attached to the extensor tendons. Motion is limited to 50 per cent flexion of the wrist and 38° extension. Roentgenogram of the left wrist shows no involvement of the bones. There is no pain, no tenderness and no increased heat. Diagnosis: Ganglion. Operation.—January 3, 1928. A linear incision was made over the mass. The process involved all the tendon sheaths except that of the thumb.

There was hypertrophy of the synovial fold and fatty infiltration. The process extended down between the fibers of the tendons. By sharp dissection the entire sheath was excised. Incision closed without drainage.

Pathologic Report.—There is dense fibrous tissue with round cell infiltration and moderate vascularity. There are dense cellular plaques surrounded with fibrin. Diagnosis: Chronic tenosynovitis. There is no evidence of tuberculosis although it resembles a tuberculous process.

The above cases are reported in detail to illustrate an advanced involvement of important structures without clinical evidence of a marked inflammatory process. For this reason the presence of a cyst and limitation of motion with or without pain, however slight, indicates early operation and radical

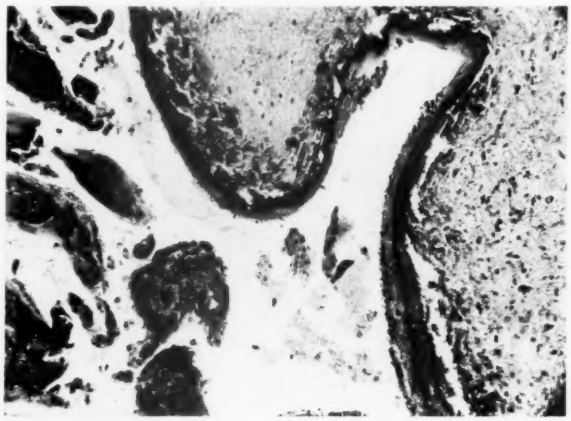

FIG. 6.—This is typical subacute synovitis with numerous masses of fibrin undergoing hyaline degeneration and forming the well known "rice bodies." The process is apparently non-tuberculous. (S-34-2520, Hist. No. 9989.)

excision of involved tissue. In general the age group is somewhat higher than in the cases with a simple cyst.

Associated lesions in other parts of the body are infrequent enough to be of little value in arriving at an accurate diagnosis. In only three of this group of 23 cases was there tuberculosis elsewhere. One had had a tuberculous kidney removed, one a tuberculous osteomyelitis and the third developed a tuberculous cervical adenitis seven months after the appearance of the cyst of the wrist. The remainder showed no evidence of the disease from the clinical or roentgenologic study.

Treatment.—In simple cystoma various methods of treatment have been advocated. The method of breaking the cyst by a sharp blow, causing extravasation of the contents into the surrounding tissue, is still in use. This results in a cure in a small percentage of cases, but the majority so treated recur. Such measures, however, are hazardous, as the character of the cyst may be such as to result in an extension of an inflammatory process which, as already stated, may be present without giving clinical evidence. Case 1 in the first group, as noted, had such a procedure carried out on two different occasions, and as the operative findings indicate, would, had there been a low grade inflammatory or tuberculous process present, have resulted in extension

of the process and, in all probability, a destruction of the parts and their function. Case 1 in the second group, as shown, had no clinical signs of an inflammatory process in the cyst, yet the pathology was advanced and, had this procedure been carried out, grave results might have followed.

The "leave it alone" type of treatment is equally harmful and probably is the chief reason for the extensive processes that are so often seen. The injection of sclerosing solutions which has received such widespread recognition as a treatment for other conditions will effect a cure in selected cases. Figure 3*b* shows the result of an injection of a modified Carnoy's solution.

Operation with complete dissection and removal of the entire cyst wall results in fewer recurrences and it is the treatment of choice. Furthermore, without operative interference, one cannot be certain of the underlying

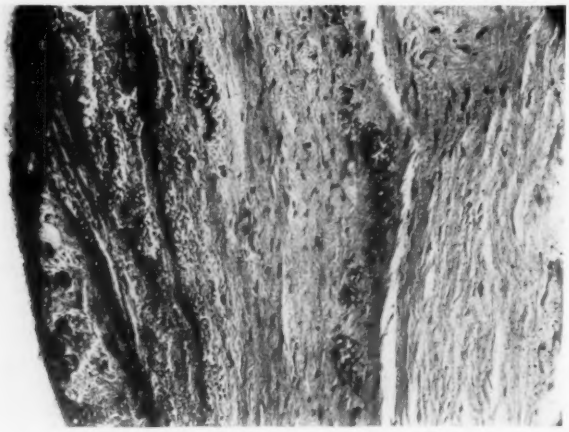

FIG. 7.—Ganglion. A small cyst showing desquamation of the lining cells so that they are more evident than they are in situ. The surrounding tissue shows definite subacute inflammation and some hemorrhage. (S-34-2153. Hist. No. 110407.)

pathology. An early tuberculous process may be present without giving positive clinical evidence. If not completely excised, it may extend to the surrounding tissue and destroy the function of the parts.

In simple cystomata without pain or limitation of motion, complete dissection and removal of the sac is important or recurrences may be frequent. In cystomata with pain and limitation of motion, early operation is indicated, as the underlying pathology is usually chronic inflammatory or tuberculous in character. All involved tissue should be completely and thoroughly excised and the incision closed without drainage.

RESULTS.—In 21 cases of simple cystomata treated by operation, there were five recurrences, varying from two months to a year. One of these was reoperated upon with no recurrence after three months. In the second group of 23 cases, an inflammatory condition of the cyst was suspected and all were hospitalized for operation. Two cases were followed for one year, and the results were excellent, with no recurrence of the cyst, no pain and no interference with function. One case which, pathologically, showed no evidence of tuberculosis, returned in six months with recurrence of the cyst, and, at the second operation, the scaphoid bone in the same wrist was found to be

involved in a tuberculous process. This was excised. Two years later she had practically ankylosis of the wrist and no motion in the fingers. Another patient with tuberculous tenosynovitis had no recurrence after 18 months, although she felt some pain and there was a small nodule above the site of the previous pathology. One patient, after excision of a tuberculous ganglion, died seven years later of generalized tuberculosis. The sixth patient followed for ten years. Case 1, reported in the second group, had slight dorsal and palmar flexion, pronation complete, supination 50 per cent and all movements of the fingers limited. There was a small swelling on the outer aspect of the dorsum of the same wrist which, he stated, had not changed in size in several years. The other patients could not be traced.

CONCLUSIONS

(1) The various theories on the origin of ganglia and synovial cysts are presented, with a comparatively new one restated, that they have their origin in embryologic arrests in the process of the development of the pariarticular tissue and synovial membranes.

(2) The morphology and pathology of ganglia and synovial cysts are essentially the same and are similar to the hygromata of bursae.

(3) Clinical distinction between the cystomata that occur in the periarticular areas is often impossible.

(4) Inflammatory disease may be present in these cysts without giving positive clinical evidence.

(5) When a cyst is present with pain and limitation of motion, however slight, early operation is indicated because the underlying pathology is usually chronic inflammatory or tuberculous in character.

(6) Various methods of treatment are presented. Operation and complete excision of all involved tissue result in the highest percentage of cures.

(7) A certain percentage of failures occurs even after the most careful dissection; they can be reduced by early and complete excision of all diseased tissue.

I am indebted to Drs. Eugene Pool and George Heuer for their kind permission to review the records of the New York Hospital, and to Dr. N. Chandler Foot for his generous assistance with the microscopic sections.

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TWENTY YEARS' EXPERIENCE WITH THE CITRATE METHOD OF BLOOD TRANSFUSION*

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THE majority of physicians and surgeons in active practice today do not appreciate the remarkable simplification that blood transfusion has undergone in the past 20 years. The older members of the profession still remember the cumbersome technic which a direct blood transfusion by vessel anastomosis entailed. Direct transfusion represented a major surgical procedure, often lasting over two hours. In addition to the technical difficulties there always existed the uncertainty as to how much blood had been actually transferred from donor to recipient.

However, "necessity is the mother of invention." With advancement in surgical technic and methods, broadening both the indications and the scope for major surgical procedures, it became evident that a simpler method of blood transfusion than the direct method was imperative in order to prepare patients more adequately before operation and to support them in their postoperative course. Furthermore, it was evident that the only way to replace a large loss of blood due to hemorrhage in the shortest possible time was to introduce a simple method for the transfer of blood from donor to recipient.

Thus the different indirect methods were born in rapid succession. Lindeman's syringe-cannula method[1] was followed shortly by the Kimpton-Brown tubes,[2] by the Unger apparatus,[3] and by the citrate method.[4]

In the short space of two years, transfusion had been transformed from a most difficult surgical procedure, requiring expert surgical skill, to a very simple one. In addition, all the indirect methods allowed exact calculation of the amount of transfused blood and thus replaced the inaccuracies incidental to direct transfusion.

In spite of the simplification of the technic, blood transfusion failed to gain general popularity, because of the comparatively great number of post-transfusion chills. The profession felt that in very sick patients—and after all the vast majority of the patients who required blood transfusions were seriously ill—a chill might be of serious consequence to the patient who was hovering between life and death.

Many different theories were brought forward to explain the chills. Some thought that chills could be prevented if specially prepared glassware were used. Others blamed the ordinary rubber tubing and introduced specially manufactured tubing in order to prevent chills. Another suggestion was that the donor should be starved before the transfusion. Others went so far as to apply this principle not only to the donor, but to the recipient.

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Many authors felt that chills could be prevented, if proper safeguards were taken to insure against cooling of the blood during the introduction into the recipient. Even in recent years complicated and expensive electrical apparatus was put on the market to keep the blood at a uniform temperature during the infusion.

I have never used any of these devices or suggestions, as I always felt that none of them was the real cause of posttransfusion chills. I used to surround the glass cylinder containing the citrated blood with hot water bottles. I discarded them a few years ago, as the slight degree of cooling of the blood occurring during a transfusion had no harmful effect on the recipient and did not cause chills. Furthermore, it is unnecessary to put the glass jar with the citrated blood into hot water during the short period required to introduce the cannula into the recipient's vein and to prepare the apparatus necessary for the transfer of the blood.

After all these different theories had been discussed for years, without solving the problem of posttransfusion chills, it was established a few years ago by Rosenthal[5] that chills were due, firstly, to foreign protein reactions, and, secondly, to defects in the distillation of the water.

Careful cleansing of instruments, tubing and glassware immediately after the transfusion is essential. A detailed technic for the safe and thorough removal of old blood which causes these pyrogenic reactions was reported in a previous paper.[5] The great importance of the use of triple distilled water for the prevention of chills was stressed. The importance of triple distillation of the water was doubted by Elser and Stillman.[6] However, its great value in the prevention of chills has been confirmed recently by studies emanating from the Institute for Blood Transfusion in Leningrad.[7]

Following the introduction of this simple technic for the preparation of instruments and solutions, posttransfusion chills on the wards of Mount Sinai Hospital were reduced from 12 per cent (1930) to 1.2 per cent (October, 1931–October, 1932). An even more marked reduction in the number of chills was observed by Satunov[7] (Novøgorod), namely, a drop from 53 per cent to 2.7 per cent chills after adoption of this technic of carefully cleansing the instruments immediately after the transfusion and of using triple distilled water.

Since the introduction of these new methods, which proved that posttransfusion chills are preventable, the citrate method is now used practically exclusively in our hospital. Up to 1932, the medical services and one of the surgical services had favored the Unger method, because it was assumed that sodium citrate, though the technical simplicity of the citrate method was conceded, was the cause of the frequent chills (Table I).

In other words, in 1932, when the new technic for the preparation of instruments was introduced the proportion between citrate and Unger transfusions was about two to one; in 1935, the proportion rose to about eighty to one.

Most hospitals have selected one method for blood transfusion, using

either citrated or noncitrated blood. In our hospital both the Unger and the citrate method were used extensively for about 17 years. Both methods had their staunch supporters. However, since the reduction of chills to a minimum, the Unger method is hardly used at all any more, even on the medical services where many transfusions are given for a great variety of blood diseases.

TABLE I

STATISTICAL RÉSUMÉ SHOWING THE RELATIVE USE OF THE CITRATE AND UNGER METHODS

	Number of Transfusions	Citrate Method	Unger Method
1923	143	83	60
October, 1931—October, 1932	477	331	146
1935	794	784	10

The present investigation (frequency of posttransfusion chills in 1935) was undertaken to find out whether the chills had been kept at the low level reported in 1932. It is easy to get good results immediately after a new technic has been introduced and every member of the organization tries hard to establish a good record. However, a certain laxity may creep in later and spoil the results. It is gratifying to note that the incidence of chills after citrate transfusions by the gravity method has been kept on the same low level, 1.2 per cent (Table II).

TABLE II

INCIDENCE OF CHILLS AFTER CITRATE TRANSFUSIONS IN 1935

723	Citrate transfusions with 11 chills..... (including pediatric service: 70 transfusions—Hirsch apparatus—with 3 chills, 4%)	1.5%
653	Citrate transfusions with 8 chills..... (exclusive of pediatric service)	1.2%

Not included in statistics:

Aplastic anemia, 61 transfusions with 12 chills

Total number of citrate transfusions..... 784

Of further interest is the fact that with the change in the original method on the pediatric service the percentage of chills rose to 4 per cent in 1935, whereas in 1934, before the technic had been changed, it had been 1 per cent. During the last year this service replaced the gravity method by the Hirsch apparatus.[8] The collection of the blood is the same as with the original citrate procedure. However, the apparatus is used to inject the citrated blood into the vein of the infant.

This apparatus consists of a metal case with two narrow channels, through which the blood is aspirated and injected. The proper cleansing of the channels through which the blood flows is very difficult. Thus old blood is apt to collect and stay in them. The increase in chills observed during the

last year on the pediatric service is due to a foreign protein reaction. The quadruplication of the incidence of chills seems to prove the advisability of adhering strictly to the original technic (gravity method).

I have not included in the statistics three cases of aplastic anemia observed at the hospital during 1935. The extremely high incidence of posttransfusion chills in this disease is so utterly at variance with the low record of chills in all other diseases that it would be unfair to include them in our statistics. They must be due to the underlying disease and cannot be ascribed to a faulty technic of blood transfusion. The first case had 31 transfusions with four chills, the second case had 18 transfusions with eight chills, and the third case had 12 transfusions without a chill. In other words, 61 transfusions for aplastic anemia were followed by 12 chills (20 per cent).

However, I have included in these statistics three cases of posttransfusion chills in ulcerative colitis, though two of these patients had been treated with dysentery serum. One patient had one chill among three transfusions, the other patient one chill among five transfusions, and the last patient had one transfusion followed by a chill. While two of these chills may have been due to a serum reaction, they were included in the statistics.

The results obtained since the establishment of the special department for the proper preparation of instruments and solutions used for intravenous therapy (saline solutions, glucose solutions, blood transfusions) prove conclusively that chills after citrate transfusions can be held permanently at a very low level (about 1 per cent), if the proper technic in the preparation of the instruments and solutions is used. The only change in the administration of a citrate transfusion since its original introduction 20 years ago is the change from a rapid infusion of the blood to the slow-drop method. The slow-drop infusion of saline and glucose solutions was first suggested by Friedemann[9] in 1913. He has used this method continuously for over 20 years and has published a number of papers on this subject. The slow-drop infusion was popularized in this country by Hyman and his coworkers.[10] I consider the slow-drop infusion, which safeguards against a sudden overloading of the circulatory system, one of the most important additions to the technic of blood transfusions. This principle can be utilized only when citrated blood is used. Citrated blood through the mixture with an anticoagulant may be introduced very slowly by the drop method without the risk of coagulation of the blood.

On the surgical services the majority of transfusions are given during the postoperative course in connection with the intravenous administration of glucose solution. The picture as it presents itself is usually the following: The patient has been returned to the ward and glucose solution is administered intravenously by the drop method. In fact, the intravenous glucose infusion usually has been started in the operating room. I use this method in practically every major abdominal operation, as soon as the patient reaches the operating room. The patient is then returned to the ward with the infusion apparatus in place. Whenever blood transfusion is indicated,

the glucose solution in the glass container is replaced by citrated blood. After the desired quantity of blood has been given, the intravenous administration of glucose solution is continued. Sometimes this procedure is repeated, blood being given again six or 12 hours later (and if necessary even at shorter intervals). In many instances the patient is not aware of the seriousness of his condition and does not know that a blood transfusion is being given. The citrate technic is the only procedure which allows us to change from one method (blood) to the other (glucose) with the greatest ease, as the exigencies of the case demand.

The sudden increase in the number of transfusions, since a safe method for the prevention of chills was introduced, is possibly partly due to lax indications. As blood transfusion may be given now without any discomfort to the patient, it is tempting to order transfusions without definite indications. I would like to sound a note of warning against indiscriminate use of blood transfusion which may not only be harmful to the patient, but would bring discredit to the method.

It is gratifying to see how the citrate method of blood transfusion has gradually overcome all the strenuous opposition which it encountered in its earlier years. It has traveled across the ocean and is now used even in small communities as far removed from us as Siberia. It has long been proved that citrated blood is absolutely harmless and may be used in any disease in which transfusion is indicated. With the present technic of the preparation of instruments and solutions the chills have been practically eliminated.

Bull[11] stated recently: "In a review of methods the place of honor unquestionably belongs to the citrate method of Lewisohn which has the longest record of accomplishment. This it owes to widespread use and to its technical simplicity which adds it to the armamentarium of any doctor who can introduce a needle into a vein accurately and carry out a few simple directions."

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DISCUSSION.—DR. WILLIAM DEW. ANDRUS (New York) reported some of the statistics of transfusion from New York Hospital. In one section of 65 beds, in a period from September, 1934, to 1936, 634 transfusions were given with 13 reactions. There was at least one case of aplastic anemia. The method used was that described by Doctor Lewisohn, and the citrate solution was prepared in Doctor Elser's laboratory. In addition, Doctor Andrus spoke of two individual cases who had received a long series of transfusions. One was a case of Streptococcus septicemia in which 37 small repeated transfusions were employed, with two reactions. The other case was a boy with hemalytic Staphylococcus osteomyelitis and septicemia. In a period of several months he received 86 blood transfusions with two reactions.

DR. FRANK B. BERRY (New York) said that although nearly everyone was familiar with the work that Doctor Lewisohn had done and the very brilliant results that could unquestionably be obtained with the citrate method, nevertheless there are certain instances in which it is not possible to have control of the preparation of the solution so that the more direct methods were indicated.

DR. R. S. MUELLER (Bellevue Hospital, New York) expressed his preference for the direct method of blood transfusion for the following reasons: First, the blood in the direct method is out of the body for only ten or 15 minutes, during which time it comes in contact only with the glass and metal syringe which are invariably washed out after each use. With the indirect method, the blood is out of the body a considerably longer time, temperature changes can take place, a chemical mixing occurs with the blood, there is a rubber tube, and the blood has to be sterile. A second reason for favoring the direct method is that in cardiac cases on the medical and surgical services, and in transfusions during operation, it is possible to feel one's way along; that is, with the direct method one can give as little or as much as desired. Moreover, by using the Lindeman needle, part may be given before operation and, by leaving the needle in during the operation, an additional amount, if required, may be given after the operation.

DR. CONDICT W. CUTLER, JR. (New York) said that although his immediate association with the method and results of transfusion has been only that of the general surgeon, nevertheless he had been very much interested in the preparation of intravenous solutions, having taken up this problem three years ago at a time when, in Roosevelt Hospital, a great many chills were occurring not only from intravenous blood transfusions but from the intravenous injection of other solutions. Following the brilliant work of Doctor Lewisohn, he undertook to find some solution of this problem at Roosevelt Hospital, and a method was instituted which involved careful distillation of the water, accepting the dictum that undistilled water was most likely the source of the reactions. Furthermore, a careful, uniform technic of preparation of the tubing and glass was adopted, as was the use of an infusion set. These methods were followed by a reduction of infusion reactions from 18 or 20 per cent to less than 0.3 per cent. It has not been possible even yet to get the result desired. Infusion reactions should be entirely eliminated. One

hampering feature was being unable to obtain a triple still so that it was necessary to resort to the use of baffle plates installed in the old still, which is not ideal even though a real improvement.

The chill reactions as applied both to transfusion and infusion may occur from other factors than simply undistilled water. Two rather interesting instances illustrate this. It was felt that very satisfactory results were being obtained when, all at once, there developed 11 infusion chills. A check up investigation revealed the fact that the granular salt was coming from the drug room. The method of handling it there was investigated and it was discovered that a metal cup was being used for measuring both salt and boric acid crystals. As soon as that was stopped and the measuring of salt was transferred to the department's preparation room, reactions ceased.

Lately, however, several reactions occurred for which it was impossible, for a time, to ascribe a reason. On thorough investigation, it was learned that someone had succeeded in selling to the hospital the idea that there is a certain type of rubber tubing which does not need preparation. This had been employed without Doctor Cutler's knowledge. As soon as the use of this tubing, that had not been prepared with sodium hydroxide, as was previously the custom, was discontinued and new tubing was subjected to sodium hydroxide, the difficulties were momentarily at an end.

Doctor Cutler stressed the importance, also, of using thoroughly distilled rather than imperfectly distilled water. Within the past five or six days, he said, in the midst of a very satisfactory record and a continuation of the process that had been developed, transfusion chill reactions again occurred which were traced down only with considerable difficulty. Every part of the technic was checked over and over without revealing the flaw. Then a specific investigation was undertaken of the still and the baffle plates, and, finally, inquiry was made into the condenser. Thereupon it was discovered that in the reorganization of the system the condenser had not been taken down. This was immediately done and the coil removed. It was found that there was a leak permitting undistilled water from the jacket to penetrate the tube that carried the distillate. Certainly an experience of this kind points out the necessity of keeping the distillate free of undistilled water.

Dr. Howard Lilienthal (New York) referred to the important matter of rapid or slow introduction of blood or fluid, particularly of blood. This depends, he said, entirely upon the nature of the conditions that call for transfusion. When a disease is accompanied by anemia, slow transfusion is best. But in the case of a healthy person who has been operated upon with the loss of a large quantity of blood, this should be replaced as rapidly as possible. Tremendous credit for the kind of work that has been done at Mt. Sinai Hospital belongs to Doctor Rosenthal. Whereas, formerly there was a certain percentage of reactions, since the establishment by Doctor Rosenthal of a central department for making and preparing solutions, the absence of reactions has become pronounced. This department takes care of the preparation of apparatus as well as of solutions.

Dr. Paul C. Morton (New York) reported that, in 1930, similar difficulties had occurred at St. Luke's as occurred two years later at Roosevelt Hospital. At that time the general principles given by Doctor Lewisohn were followed. After two years' investigation and experimentation, in 1932 a special room was equipped for the preparation of intravenous solutions and equipment. A few minor modifications were made in the Mt. Sinai technic, such as an increase in the size of the metal box, an increase in the size of the gravity flask, and separation of the clysis sets from the infusion sets. The

general technic of rubber, and solution preparation, remained the same. During the four year period, from 1932 to 1936, 11,173 infusions have been given, with nine reactions, eight of which occurred in a period of four months, the source of contamination having been in a gelatin seal which covered the glucose ampule cap. Whenever any of this gelatin seal fell into the gravity flask a reaction occurred, and as soon as the technic of adding glucose to the solution was changed, and double-tipped glass ampules used, reactions ceased.

Four months ago, however, one other chill was encountered, following an intravenous treatment. It has seemed impossible to determine the cause of this reaction. It has been the experience at St. Luke's that whenever a reaction occurs, it can be traced back to some break in technic, the chills and reactions being due to a foreign protein entering the system through a direct contamination, as noted above: through improperly distilled water, or through improperly prepared rubber tubing. Experiments in Doctor Morton's hands have shown that improperly prepared rubber tubing will produce chills. It is felt now that triple distilled water is not essential, but that great care should be used in keeping the still clean and in having a high boiling chamber and adequate baffle plates. When this is done consistently good results following Doctor Lewisohn's technic, either in blood transfusions or in the introduction of fluids intravenously, can be expected.

In Doctor Morton's experience, hydrogen ion concentration has played no part in the production of chills. Neither has temperature of the solution. Speed shock has not been encountered, intravenous solutions having been given as rapidly as 1,000 cc. in ten minutes, and as slowly as the drip method can supply the liquid without having the blood clot. No chill has been dependent upon this factor. Neither has concentration of the solution produced chills. As much as 200 cc. of 20 per cent salt solution, 50 per cent glucose solution in plain distilled water, has been given without untowards effect.

In reference to the sale of commercially prepared solutions for intravenous use, Doctor Morton said that at various times members of the staff at St. Luke's Hospital have been interviewed by all the companies making commercial solutions. In spite of the greatest confidence in the chemical purity of the product, experiences at St. Luke's do not concur with the statements of those who claim that they have not encountered chills and reactions with such solutions. The uncontrollable factor in these preparations lies in the rubber tubing through which the solution is given. The original tubing as distributed with the sets is adequately prepared, but, following its initial use, it is used over and over again with other flasks, and is, in the greatest majority of cases, inadequately prepared, so that it proves to be a source of contamination and constitutes the great danger that lies in the use of commercial transfusion preparations.

Doctor Lewisohn (closing) stated that he was surprised to hear that a number of hospitals in this city still use the syringe method, in spite of the fact that the citrate method is simpler and safer. It might be of interest to point out that the Lahey and Mayo Clinics use the citrate method, with the same good clinical results and the same low incidence of chills as reported at Mt. Sinai and other hospitals using the citrate method.

FATTY ACID SOLUTIONS FOR THE INJECTION TREATMENT OF VARICOSE VEINS

EVALUATION OF FOUR NEW SOLUTIONS

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SCLEROSIVE therapy by the injection method has developed a new phase. The search for an ideal solution has resulted in the submission of a new group of obliterative agents, the results of the employment of which forms the basis of this communication.

In 1933,[1] the polyglot mixture known as sodium morrhuate was evaluated and it was pointed out that a more perfect solution could be derived from this source by the isolation of the proper fatty acid compound. The sclerosing action of sodium oleate, which is one of the chief constituents of sodium morrhuate, was also described. Following this investigation, a number of chemists attacked the problem of isolating the active ingredients in the older preparations.

The four new solutions herewith described are the result of this research and all contain fatty acids. It is felt that a definite advance has been made in the fact that these newer tissue irritants are toward the fatty acid group. It has long been considered that there is no particular virtue in any one sclerosing solution. The pathology following obliterative therapy is of the same general type in all cases and depends upon the degree of irritation, rather than upon any peculiar chemical action. It follows, therefore, that the solution of choice would be one that resembles the natural body humors. Fatty acid salt solutions are normally found in the body as a result of digestion, being formed in the intestinal villi by the saponification of ingested fats. In high concentration these solutions are irritating to the tissues and therefore become ideal sclerosing agents.

Before describing the new solutions, it may be well to recall their chemical background. The parent compound, sodium morrhuate, is a mixture of the fatty acid salts derived from cod liver oil by saponification. It is really a liquid soap solution; in other words, a cod liver oil soap. It is important to keep these facts in mind during the following discussion.

MORU-QUIN.—This preparation is a combination of the two most widely used preparations; namely, sodium morrhuate and quinine. It is made in two strengths: Moru-Quin A contains sodium morrhuate 5 per cent, quinine alkaloid 2 per cent, and benzyl alcohol; Moru-Quin B contains sodium morrhuate 10 per cent and 2 per cent of the other two ingredients. The concentration of quinine in either mixture is only 2 per cent as contrasted

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with 13 per cent in the older preparation of quinine and urethane. The important ingredient, therefore, is the sodium morrhuate. I have never observed any "quinine effect" from the use of this solution in ordinary quantities. It has been claimed that this is due to the formation of a loose chemical combination called "quinine morrhuate." However, the low concentration of quinine in the preparation is the more probable answer.

Moru-Quin B, the 10 per cent solution, is of a syrupy consistency, which makes it difficult to use. I have found little occasion to employ this molasses like mixture, although in occasional stubborn cases it has produced sclerosis where the 5 per cent mixture failed.

Moru-Quin A was first personally employed in November, 1933. In the past two and one-half years, it has been used 750 times. In sclerosive efficiency it stands a little higher than plain sodium morrhuate (Table I). The solution, on standing, becomes turbid but clears on gentle warming. There is no cramp following injection. Accidental perivascular injection may produce sloughing a little more readily than is the case with plain sodium morrhuate. However, it is definitely less prone to cause tissue necrosis than ordinary quinine and urethane.

I find that Moru-Quin is a definite addition to our armamentarium. It is especially useful in preparing the patient for quinine therapy. By its use a quinine idiosyncrasy may be detected and a tolerance built up to avoid cinchonism. It is, therefore, a good stepping stone toward the use of plain quinine when this reagent is indicated.

In the modern treatment of varicose veins a variety of solutions are necessary. Due to the frequent presence of latent phlebitis, it is necessary to begin with a weak solution and work up towards a more irritant preparation.[2] By carefully increasing the irritating action of the therapy it is possible to avoid severe migrating reactions. With a greater variety of sclerosing solutions the modern operator has an increasing flexibility of technic and can more carefully control his results. Moru-Quin, despite the few advantages it possesses, fills a useful niche midway between the weaker and stronger members of the endothelial irritants.

Oleate Quinine.—This preparation, which I have used 400 times in the past two years, is a mixture of 5 per cent potassium oleate, 2 per cent quinine alkaloid, and 2 per cent benzyl alcohol in water. The formula is definite and unvarying. There is no clouding of the solution even after prolonged standing. The average injection of 2 cc. causes a firm thrombosis in over 90 per cent of cases.

Clinically, its sclerosive action is as uniform as its formula. Again, no "quinine effect" results because of its low concentration in the mixture. Due to the irritating qualities of the solution, it should never be employed at the outset of a case. There is no cramping upon injection, and clinically I have not observed any allergic reactions.

From the cosmetic point of view, it must be employed cautiously. It

is of such an irritant nature that it often excites pigmentation over the affected vein, and is also apt to cause bulky nodular thromboses which absorb slowly. Its sclerosive efficiency, as shown in Table I, is slightly less than that of quinine and urethane, and it is also less likely to cause a slough formation than this older preparation.

Oleate Quinine is extremely useful as a routine solution. It has a constant, dependable sclerosive action, and is a definite improvement over the morrhuate type of solution.

Sylnasol.—My interest in this solution dates from March, 1935, when the preparation known as sodium psylliate was offered to me for testing purposes. This solution, containing the sodium salts of the fatty acids derived from the psyllium seed oil, at first acted like a weak substitute for sodium morrhuate. Subsequent improvement resulted in a more stable and efficient preparation which is now marketed under the name of Sylnasol.

Before putting Sylnasol to wide clinical usage, it was necessary to study its toxicity. Laboratory tests disclosed the fact that adult white rats could tolerate 1¼ cc. of sodium psylliate intravenously without ill effects, except for temporarily labored respirations. This corresponds to 450 cc. in human beings weighing 60 kilos. Obviously, there is a wide margin of safety with the use of this reagent.

Further studies were then made of the hemolytic action of Sylnasol in comparison with two allied solutions, sodium morrhuate and sodium resinoleate. The materials used in the test were a 5 per cent suspension of whole human blood in normal saline solution and varying dilutions of the drugs with normal saline. It was concluded from this study that Sylnasol was less hemolytic in all dilutions than sodium morrhuate. It was also observed that sodium resinoleate in the stronger solutions hemolyzed the corpuscles more rapidly than sodium morrhuate or Sylnasol. It is evident that Sylnasol is a comparatively safe solution for clinical use.

Clinically, Sylnasol has been used by me 800 times in the past year. It is less irritating than sodium morrhuate (Table I). I have never observed any definite dermatitis arising from its use. There have been occasional cases who complained of arthritic pains during the course of Sylnasol therapy. This symptom has also been observed with other fatty acid salt solutions, and is indeed a puzzling phenomenon. It must be remembered that the age group of various veins coincides with that of arthritis and that joint pains complained of during therapy may well be coincidental. The problem needs continued study before any definite answer may be attempted.

The mode of action of fatty acid preparations forms an interesting problem. It has been held that there is a relationship between the hemolytic action and the sclerosing effect. However, the fact that so many fatty acid salt solutions of varying hemolytic power are sclerosive in nature indicates another type of action. Experimentally, I have found that ordinary commercial liquid soap also has sclerosive power. It is well known that soap lowers sur-

face tension. This "soap effect" may be one of the factors in the mechanism of thrombosis with this type of solution.

A curious but comparatively rare occurrence with Sylnasol is the appearance of a throbbing, pulse like pain in the region of the loin immediately following injection. This occurs more readily on the left side and is apparently due to renal irritation. It is an alarming but transitory phenomenon, generally disappearing within 15 minutes. In the few cases that have complained of this peculiar pain, I have been able to reproduce it with subsequent injections. Patients exhibiting this idiosyncrasy should be changed to another solution.

In varicose veins Sylnasol fills an important need for a mild irritant, especially in cases of phlebitis. It is the safest of the newer fatty acid preparations, and I have never observed any slough following its use. It causes no cramping and resembles morrhuate in the type of thrombosis produced. It has, in my opinion, a definite sphere of usefulness in the obliterative therapy of varicose veins. Its place in the family of chemical irritants is shown in Table I.

Monoethanolamine Oleate.—This solution is the result of the last few years of investigation for the ideal obliterative agent. It is an oleate similar to the sodium oleate I employed for varicose veins in 1933. It contains an organic base combined with oleic acid, and is thus a definite chemical compound that can always be prepared in batches which are perfectly comparable. In this way it overcomes the main objection to sodium morrhuate and Sylnasol which vary from batch to batch.

Monoethanolamine oleate is a pale amber solution that remains clear indefinitely without losing its sclerosive potency. Its formula is $C_{17}H_{33}COONH_3CH_2CH_2OH$.

Pharmacologic tests show that the M.L.D. intravenously in rabbits constantly runs 130 mg. per kg. This is in contrast to sodium morrhuate which varies from 100 to 125 mg. per kg., so that it is somewhat less toxic than sodium morrhuate. I have never observed any toxic effects from the clinical use of this solution in an experience of 500 injections. There is no pain or cramping on injection. Perivascular accident is only productive of slight discomfort, and sloughing will probably be a rarity because no necrosis has as yet been observed in my series of extravascular injections.

As shown in Table I, its efficiency as a sclerosive agent is very high, ranking next to quinine and urethane when used in similar quantities. In larger amounts, it surpasses quinine in efficiency because it may be used in 5 cc. quantities, while quinine is rarely used in amounts over 3 cc. The thrombi produced are as firm as those following quinine therapy. Pigmentation sometimes occurs in brunettes if the reaction is pronounced. As an efficient nontoxic, dependable vascular sclerosive agent, there has been nothing in my experience which surpasses monoethanolamine oleate.

From the allergic viewpoint, little of a definite nature can be stated, except that I have never observed dermatitis of the "morrhuate" type following the

use of monoethanolamine oleate. The problem of fatty acid salt injections in relation to dermatitis is as yet confused. The work of Jordan, *et al.*,[3] shows that soaps in dilute solution cause a dermatitis after patch testing in approximately 50 per cent of individuals. This proportion is higher in patients with other forms of allergy, probably as a result of polysensitivity. These workers found that the alkali content of soap solutions is of minor importance in this respect.

It is clear that soap solutions in contact with epidermis often cause dermatitis; monoethanolamine oleate, being a soap, will also behave in this manner. However, there should be no skin contact with correct intravenous therapy. Furthermore, in the circulating blood stream, the fatty acids are altered, as has been amply proved, prior to oxidation or absorption. Theoretically, therefore, there should be no dermatitis following the careful intravenous use of this solution. Practically, as has been stated above, no allergic dermatitis has been noted. This reasoning does not apply in the case of sodium morrhuate because of the probable presence of a protein fraction normally found in cod liver oil.

Monoethanolamine oleate, up to the present time, stands out as more closely approaching the ideal endothelial irritant than any other solution in use.

TABLE I

ORDER OF INCREASING SCLEROTIC POWER

Solution	Classification	Amount Injected	Untoward Reactions	Indication
1. Dextrose.....	Organic	2–20 cc.	None	Latent phlebitis
2. Invert Sugar.....	Organic	2–20 cc.	Cramp only occasionally	Phlebitis and routinely as first injection
3. Sodium Chloride 20%.....	Dehydrant	5–20 cc.	Cramp	Dilated venules for smooth thrombosis
4. Dextrose and Na Cl.....	Mixed	5–20 cc.	Cramp	Where smooth cosmetic result is desired in varicose veins
5. Sylnasol, 5% and 10%.....	Soap	2–5 cc.	Renal colic	Varicose veins
6. Sodium Morrhuate.....	Soap	2–10 cc.	Dermatitis	Varicose veins
7. Moru-Quin A....	Mixed	2–5 cc.	Occasional dermatitis	Varicose veins
8. Oleate Quinine...	Mixed	2–3 cc.	Pigmentation	Varicose veins, resistant veins
9. Monoethanolamine Oleate...	Soap	1–3 cc.	None	Varicose veins, resistant veins
10. Quinine and Urethane.....	Organic	1–3 cc.	Cinchonism, pigmentation	Varicose veins, resistant veins
11. Sodium Salicylate 30 to 40%.....	Dehydrant	1–3 cc.	Intense cramp	Resistant veins
12. Bichloride of Mercury 1%.....	Heavy metal	½–1 cc.	Pain, hydrargyria	Rarely used, except in stubborn sclerotic varicose veins

CONCLUSIONS

(1) Four new fatty acid solutions are presented.

(2) Moru-Quin, a loose chemical combination of sodium morrhuate and quinine, is a useful new solution.

(3) Oleate Quinine, combining potassium oleate and quinine in one solution, is a stable mixture with uniform sclerosive power.

(4) Sylnasol, containing the fatty acid salts of psyllium seed oil, resembles sodium morrhuate in its action on veins.

(5) Monoethanolamine oleate, a synthetic compound of unvarying nature, is at present the most efficient sclerosive agent for use in varicose veins.

(6) Fatty acid salt solutions are an advance toward safer and more efficient sclerosive therapy.

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VITAMIN C DEFICIENCY AND WOUND HEALING

AN EXPERIMENTAL AND CLINICAL STUDY

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SPONTANEOUS breakdown of a surgical wound in the absence of infection occurs with relative frequency in patients with the cachexia of cancer, in debilitated individuals, and in young patients; notably those who have some congenital anomaly of the gastro-intestinal tract. There exists in these patients a likelihood of ascorbic acid deficiency. Since the relationship of ascorbic acid to collagen formation has been clearly demonstrated, we have endeavored to reëxamine the problem of noninfectious wound breakdown from the point of view of a possible specific relationship to vitamin C deficiency.

Cases of frank scurvy are not of frequent occurrence even in patients of the age group treated at the Children's and Infants' Hospital in Boston. There is being disclosed at this hospital by laboratory tests, however, a far greater incidence of asymptomatic scurvy than hitherto could be recognized by the usual methods of clinical examination. The term "asymptomatic scurvy" may be defined as scurvy existing in a patient without characteristic symptoms, physical signs, or roentgenologic evidence during life, but in whom the histologic changes of early scurvy are demonstrable at autopsy, as is illustrated in the appended case report.

Case Report.—No. A204,665, L. F., male, age four weeks, was admitted to the hospital because of a congenital atresia of the bowel. He had had an ileostomy performed at another hospital at the age of two days. On admission he was markedly emaciated and dehydrated. For ten days an attempt was made to improve his nutritional state. In addition to breast milk, he was given several transfusions, and daily administrations of parenteral fluids—glucose and normal saline. On the eleventh day a laparotomy was performed, and a side-to-side anastomosis around the site of the obstruction effected. The ileostomy was closed. For the next three days the patient received a continuous intravenous drip of glucose, as well as two transfusions. The abdominal wound opened on the third postoperative day. It was resutured but the patient died the following day.

At autopsy microscopic sections of the costochondral junction were described as follows: "There is a definite lattice formation and many of the cartilage spicules are fractured. Osteoblasts are present along the cartilage spicules but there is no osteoid formation." This is evidence of early scurvy. It is significant that roentgenologic examination of the wrist, taken during life, showed no evidence of scurvy. It is also suggestive, in view of our experimental findings, that sections of the skin at the operative site showed numerous fibroblasts without formation of collagen. Sections of the

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intestinal wall adjacent to the anastomosis showed proliferation of connective tissue without definite formation of collagen.

This infant had asymptomatic scurvy at six weeks of age, but during life did not show any of the clinical or roentgenologic evidences of the disease. Although this patient received some breast milk during his six weeks of life, it seems clear that he did not have enough ascorbic acid to meet metabolic requirements. It is our opinion that this was at least one factor in the failure of the wound to heal.

Minot[1] (1936) has recently stated: "The major problems of nutrition do not concern clean cut deficiency diseases, but the prevention of partial deficiency. Border line states of nutritional instability are much more common than is usually appreciated. There is a wide zone between optimal nutrition, and the level at which classic symptoms of recognized dietary deficient states develop." It is becoming increasingly apparent that vitamin C nutrition is a relative term embracing several zones of ascorbic acid depot; between saturation on the one hand and absolute depletion on the other. A large body of evidence is being assembled to show that the conception of vitamin C deficiency should include not only absolute depletion of the ascorbic acid stores, but also such low levels of supply as place the functioning of connective tissue cells at a physiologic disadvantage.

This conception of vitamin C deficiency, as well as the wide range of plasma ascorbic acid levels in human beings, is borne out by a recent study by one of us[2] at the Infants' Hospital. The ascorbic acid in the plasma was determined in 54 patients. These patients were divided into four groups on the basis of their ascorbic acid nutrition as suggested by the feeding history. The results are shown in Table I.

TABLE I

Group*	Plasma Ascorbic Acid (Mg. %—Average for Group)
I Well Baby Clinic	1.00
II Ward patients with history of good vitamin C content in diet	0.73
III Ward patients with history of poor vitamin C content in diet	0.22
IV Ward patients with frank scurvy	0.08

* It is noteworthy that only in Group IV was there clinical evidence of scurvy. Groups II and III were admitted for a great variety of causes. Group I showed no disease.

The subject of wound healing is covered by a large literature that has recently been surveyed by Arey[3] (1936). He lists 12 general factors influencing wound healing, each one of which has been the subject of numerous researches. Among other phases of nutrition, the influence of fats, carbohydrates, and proteins, in the diet, has been investigated. Likewise considerable attention has been given to the rôle of vitamins in regenerative

processes. Avitaminosis A, B, C, and D has each in its turn been reported to inhibit normal healing, with resumption of healing following ingestion, or local application, of the specific vitamin involved in the deficiency.

The attention given to local application of vitamins, hormones, peptones, chick embryo juice, and sulphydril compounds rests largely on the emphasis given by Carrel[4] (1921) to "external irritation," as the initiating mechanism of wound repair. He was able to delay cicatrization and epidermization for as long as 20 days by protecting the wound with an overlying sheet of fascia sutured to its edges. The multiplicity of specific remedies advocated for the promotion of wound healing, however, is at variance with the simple clinical fact that most wounds, not directly contaminated by gross infection, heal satisfactorily in healthy people, while those in debilitated patients may be difficult to improve under any regimen. As Höjer[7] (1924) has aptly put it: "Even if, as Carrel has pointed out, the cicatrization of wounds is apparently initiated by an external factor, the answer of the organism to the irritation is decided by internal factors." He concludes that a full supply of antiscorbutic "is necessary to an answer of normal intensity."

Normal repair of connective tissue is primarily a process of fibroblastic proliferation and the formation of collagen. Wolbach[5] (1933) has concluded that this formation of collagen is "a product of secretory activity of fibroblasts."

Wolbach and Howe[6] (1926) have characterized scurvy as an "inability of the supporting tissues to produce and maintain intercellular substance. Direct proof of this conclusion has been obtained in the study of repair of soft tissue in regard to the collagen of connective tissue." Höjer has observed that: "Before the formation of collagen is completely arrested, there is a stage where it is very unevenly distributed and irregularly arranged."

These facts rest securely upon proved pathologic studies and form the basis for an experimental study of wound healing in guinea-pigs, which were partially depleted of their vitamin C depot and subsequently maintained at a low level of ascorbic acid supply (0.25 mg. daily). The nutritional state of these animals resulting from this diet may be held analogous to asymptomatic scurvy.

Experiments.—During this study two groups, comprising normal and scorbutic guinea-pigs, were operated upon and incisions made through the abdominal and stomach wall. Subsequently at periods of ten, 20, and 30 days, representatives of each group were sacrificed for histologic study, and for the measurement of the pressure required to rupture the scars in the abdominal and gastric walls.

Diet.—Twenty-four growing guinea-pigs weighing about 200 Gm. were separated in two groups; one group was fed solely on a scorbutogenic diet, and the other on this same basic formula but with an ample supplement of green vegetable tops.

Rolled oats	35.0%	35.0%
Wheaten bran	34.0%	34.0%
Skimmed milk powder (heated and stirred for 1 hr.)	22.5%	
Butter fat	7.5%	
Sodium chloride	1.0%	1.0%

In addition 0.5 cc. of oleum percomorphum (for vitamins A and D) was given twice a week.

The group selected for the production of scurvy was given the above diet exclusively for nine days in order to accomplish, to a large degree, depletion of the vitamin C depot. On the tenth day 2.0 mg. of crystalline ascorbic acid dissolved in distilled water were administered with a pipet to each of these 12 guinea-pigs. Thereafter 0.5 mg. was given every other day for the duration of the experiment.

The scorbutogenic properties of this diet and the adequacy of the control feeding were attested by roentgenologic studies of the wrists at ten day intervals on representatives of both groups, and by the histology of the ribs at autopsy.

Operative Technic.—On the fifteenth day after starting the above diets, the 12 scorbutic and the 12 normal animals were operated upon as follows: Under ether and using aseptic technic, a one inch incision was made slightly below the xiphoid in the midline, the abdominal musculature divided by blunt dissection, and the peritoneum incised. The stomach was delivered into the wound and part of the anterior stomach wall was placed in an intestinal clamp. An incision one-half inch long was then made through the anterior stomach wall. This incision was closed with a running suture of silk, no attempt being made to invert the edges. The abdominal wound was closed in two layers, interrupted silk sutures to muscles and peritoneum, and the skin by a running suture of silk. No dressing was applied to the skin, which was cleaned with alcohol and painted with collodion.

In the scorbutic group there was one immediate operative fatality, and a second guinea-pig died during the night following operation. Two of the controls were found unsatisfactory for the purpose of this experiment, one because of gross infection of the wound and healing by second intention, and another because of faulty technic during measurement of wound strength. There were left ten guinea-pigs of each group (20 in all), for the purpose of the study.

Subsequent Procedure.—The skin sutures in both groups were removed one week after operation. At periods of ten, 20, and 30 days, three members of each group were sacrificed; two for the purpose of wound measurement, and the third for histologic study.

There were no complicating factors in the experiment as far as could be ascertained. The wounds healed by first intention and at about the same gross rate. The smooth, even abdominal scars of the normally fed group, however, at ten, 20, and 30 days postoperatively, contrasted with the rough

appearance of the scars of the scorbutic group at the same time interval (Fig. 1).

Technic of Measurement.—As in the experiments of Harvey and Howes[8] (1930), the strength of the wound was estimated in terms of its breaking point when distended by air. Our apparatus differed from theirs, however, and was constructed from a mercury sphygmomanometer with its cuff wrapped around a small bottle. Its closed circuit was connected with a free length of tubing to which a lumbar puncture needle was attached (Fig. 2). The needle was inserted into the peritoneal cavity, care being taken to avoid subcutaneous emphysema, and the intra-abdominal pressure slowly increased. The highest point reached by the mercury column, before gaping and rupture of the wound occurred, was recorded. The same general procedure was used

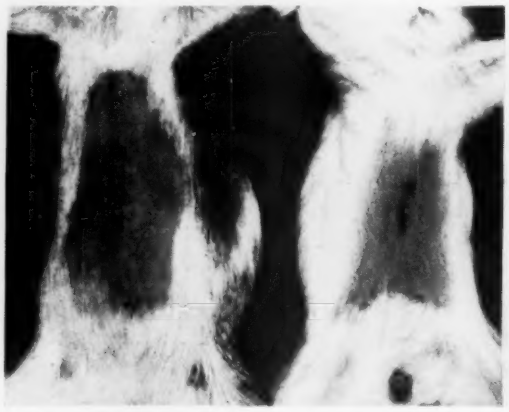

FIG. 1.—The normal animal is on the left. Note difference in gross appearance of operative wounds. (Ten days postoperative.)

FIG. 2.—Apparatus used for distending wounds in the experimental animals.

for testing the stomach wound. The organs were left in situ after opening the abdominal wall. The esophagus was clamped close to the cardia, the small intestine tied about one inch below the pylorus, and the needle inserted just proximal to this tie. We may quote Harvey and Howes in regard to the accuracy of this method of measuring wound strength: "It is conceded at once that this gives no value of the (absolute) strength of the wound, but inasmuch as the data desired, are those of relative changes in strength, the method seems adequate."

Results.—During the process of abdominal distention and rupture, there was a characteristic gross difference in tensile strength, behavior, and appearance of the two types of wounds. The abdominal wounds of the normal animals uniformly withstood far greater distending pressure than did those of the scorbutic animals. The wounds of the normal animals burst with great suddenness when they reached the breaking point; the wounds of the scorbutic animals first gaped widely at the site of the incision, and then ruptured at a slightly higher pressure. The scar tissue of the wounds of the normal animals after rupture was pink and firm, while that of the wounds

of the scorbutic animals was livid and of soft consistency. It resembled closely the appearance of the broken down wound in the debilitated human patient (Figs. 3 and 4).

It was found that the wound in the abdominal wall served better to demonstrate the difference in wound strength of the two groups, as the wound in the stomach was not always suitable for direct observation. In addition, the gastric incisions with their subsequent adhesions to liver and omentum were not precisely similar in each guinea-pig. It is notable, however, that in all the scorbutic animals rupture occurred at the wound, while in the normal animals the stomach ruptured in all cases elsewhere than at the wound, and at higher levels of pressure (Tables II and III).

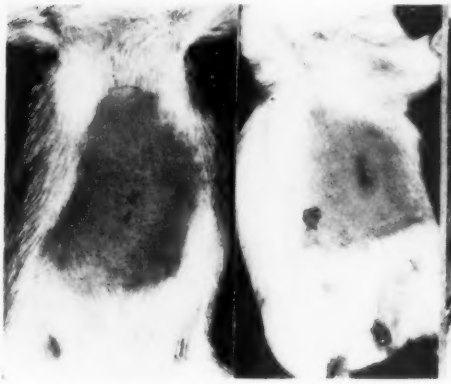

FIG. 3.—Same animals as in Fig. 1, 30 days postoperative. The peritoneal cavity of the normal animal on the left has been distended to 70 Mm. of mercury air pressure. The scorbutic animal on the right is distended to only 38 Mm. of mercury air pressure, and the wound has begun to gape.

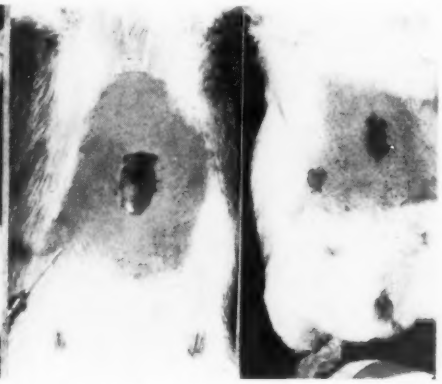

FIG. 4.—Same animals as Figs. 1 and 2: The normal animal on the left is now distended to 200 Mm. of mercury air pressure. The wound has ruptured. The animal on the right is distended to 47 Mm. of mercury air pressure and complete rupture of the wound has occurred. Note difference in gross appearance of both wound edges and the granulation tissue in the two animals.

Histology.—Sections were made through three representative areas of each wound, and stained with hematoxylin and eosin, and with Mallory's aniline blue.

The operative incision through the corium in each of the partially scorbutic animals showed connective tissue repair with but very little collagen production. A defect in the corium resulted that was easily apparent under low magnification (Fig. 5). The subcutaneous fibroblastic tissue was abnormally thick and irregular in pattern in the partially scorbutic animals, and there was very little collagen deposition ten, 20, and 30 days postoperatively (Fig. 6). Numerous extravasations of red blood cells were seen, in many of which were strands of fibrin. Hemosiderin was conspicuous in the two animals sacrificed 20 and 30 days after operation. In all control animals there was a thick collagenous layer at the site of the incision, and the original point of incision through the corium could be ascertained only by its relation to the subcutaneous scar. Healing in the controls proceeded with a plentiful

TABLE II

AIR PRESSURE REQUIRED (IN MILLIMETERS OF MERCURY) TO RUPTURE ABDOMINAL WOUNDS

Normal Animals				Scorbutic Animals			
Number	Date	Mm. of Mercury at which Wounds Gaped	Ruptured	Number	Date	Mm. of Mercury at which Wounds Gaped	Ruptured
1	10 days P.O.	..	128	1	10 days P.O.	67	85
2	10 days P.O.	..	145	2	10 days P.O.	37	60
3	20 days P.O.	..	165	3	20 days P.O.	40	50
4	20 days P.O.	..	135*	4	20 days P.O.	45	65
5	30 days P.O.	..	210†	5	30 days P.O.	62	85
6	30 days P.O.	..	200	6	30 days P.O.	38	47
	Average	..	160		Average	48	65

* Postoperative hernia.

† Abdominal wall ruptured elsewhere before wound gave way.

TABLE III

AIR PRESSURE REQUIRED (IN MILLIMETERS OF MERCURY) TO RUPTURE GASTRIC WOUNDS

Normal Animals			Scorbutic Animals		
Number	Date	Mm. of Hg.	Number	Date	Mm. of Hg.
1	10 Days P.O.	95	1	10 Days P.O.	25
2	10 Days P.O.	90	2	10 Days P.O.	34
3	20 Days P.O.	60	3	20 Days P.O.	20
4	20 Days P.O.	45	4	20 Days P.O.	40
5	30 Days P.O.	45	5	30 Days P.O.	25
6	30 Days P.O.	43	6	30 Days P.O.	34
	Average	70		Average	30
In all cases stomach ruptured elsewhere than at wound.			In all cases wound ruptured before stomach.		

deposition of collagen by the tenth postoperative day, and in the wounds of these animals hemorrhage and hemosiderosis were minimal. Both groups showed foreign body giant cell reaction about the sutures.

DISCUSSION.—Other workers have established experimentally the inability of tissues to produce intercellular substance in absolute scurvy. That the data so obtained have a valid application to human beings is the conclusion of Wolbach[9] (1937) as recently expressed in the following statement: "The gross and microscopic pathologic changes of human scurvy as seen in the infant, and experimental scurvy as seen in the guinea-pig, are so nearly identical that no reasonable doubt can be entertained with regard to applying to the human being the facts ascertained from the experimental studies." One can therefore state with a fair degree of certainty that in a patient with abso-

lute scurvy, the effective healing of such lesions as require fibroblastic repair comes to a standstill. Absolute scurvy, however, is of relatively rare occurrence. The most significant clinical aspect of this study is its possible bearing on states of partial deficiency of vitamin C.

The condition of the vitamin C deficient animals used in this study may be held analogous to asymptomatic scurvy in man. Wound healing in these partially scorbutic animals progresses in marked contrast to that observed in the controls. This contrast was manifested in inferior tensile strength, in a disposition of these wounds to gape before rupturing, and in the livid appearance of their granulation tissue and its soft consistency. Microscopic study provided what seems to be an adequate explanation for these differences. The deficiency in collagen was undoubtedly reflected in the inferior tensile strength and soft consistency of the scorbutic granulation tissue. Its lividity was probably a reflection of poor vascularization and hemorrhage.

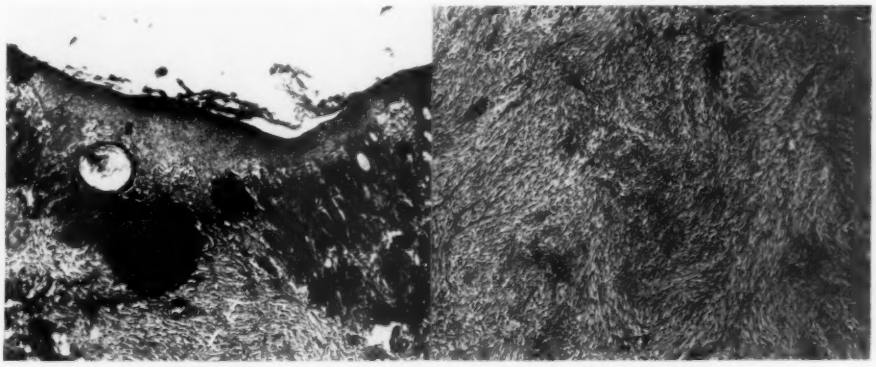

FIG. 5.—Photomicrograph of skin and subcutaneous tissue of scorbutic animal, showing the defect in the corium (low power), aniline blue stain.

FIG. 6.—Photomicrograph of the subcutaneous tissues of the same animal as Fig. 5, showing the great cellularity and irregular arrangement of fibroblasts, which are laying down very little intercellular substance—collagen (low power).

The initial gaping observed in the wounds of the scorbutic animals following abdominal distention can be ascribed to the defect found regularly in the corium. This defect was not seen in the control animals in which a new layer of collagen was laid down in the first ten days after operation. The importance of the corium in repair of the abdominal defect is also indicated by the fact that one normal animal with a postoperative hernia withstood an intra-abdominal pressure of 135 Mm. of mercury before rupture occurred (Table II). The inferior tensile strength of the wounds of the scorbutic animals 30 days postoperatively has an added importance in the light of Harvey and Howes' demonstration that the greater part of the final tensile strength of a normal wound (as measured in the rat's stomach) is attained within ten days after operation.

Vitamin C does not, of course, play the only rôle in wound healing. Indeed its part among the other vitamins may not be the leading one. The progress in the early recognition of the several vitamin deficiency states has been reported by Blackfan[10] (1937). Vitamins A, B_1, C and D can now

be determined by quantitative chemical tests. The individual bearing of all these vitamins on the healing process demands further study. It seems clear, however, that there exists a degree of vitamin C deficiency in human beings that is not recognizable by methods ordinarily used in physical examination. This degree of deficiency, or asymptomatic scurvy, may well have an important bearing on wound healing. The incidence of asymptomatic scurvy is undoubtedly more frequent than is generally realized. Its existence has been proved histologically and chemically in the age group encountered at this hospital. Its existence in older patients, though not yet proved, undoubtedly occurs. If the average daily intake of ascorbic acid falls below the minimal protective dose, the consequences of this increasing increment of deficiency, after depletion of the body depot, are evident.

In estimating the degree of vitamin C deficiency clinically, the plasma determination of ascorbic acid, by the indophenol test, serves as a very useful guide. When the figure falls much below .45 mg. per 100 cc. of plasma, it may be inferred (Table I) that the vitamin C depot is approaching dangerous depletion. In such circumstances it would seem advisable to administer about five to ten 200 mg. doses of ascorbic acid, as an initial step in preparing the patient for operation. This can be given by mouth or with intravenous fluids, and should not in the least complicate or conflict with other steps that may be indicated as a part of preoperative care.

It is evident that further work on quantitative determination of plasma ascorbic acid must be done, not only in the age group here considered but more especially in adults. Further work along this line is now under way at the Children's Hospital. It is hoped that this paper may stimulate similar studies in hospitals for adults. For it seems reasonable to suppose that in older patients, such as those suffering from prolonged obstruction due to cancer of the pylorus, there may well be a dangerously low ascorbic acid depot.

SUMMARY.—Guinea-pigs were partially depleted of their ascorbic acid depot, and were subsequently maintained on approximately one-fifth of the minimal protective daily dose of ascorbic acid. The healing of the operative incisions of these animals, both histologically and physiologically, was inferior to that of a group of control animals.

A normal wound is considered to attain the greater part of its final strength within the first ten days after operation, but the partially scorbutic animals had greatly inferior tensile strength, when compared to their controls, ten, 20, and 30 days postoperatively.

The abdominal wounds of the scorbutic group ruptured at a pressure averaging approximately one-third that required to rupture the wounds of the normal animals.

The scar tissue in these wounds was distinctly abnormal, being livid and soft in consistency. Histologic study of the wounds in the partially scorbutic group showed defective repair of the corium, and a poor production of collagen in the scar.

The clinical application of these facts is discussed, and a case in point is

cited, in which the presence of asymptomatic scurvy is thought to have been a factor in the failure of an operative wound to heal.

CONCLUSIONS

Vitamin C plays an important rôle in the healing of experimentally produced wounds in guinea-pigs.

There may exist in human beings a degree of vitamin C deficiency that cannot be recognized by methods ordinarily used in physical examination.

It has been proved, histologically and chemically, that asymptomatic scurvy is far more common in infants and children than has been realized. Its existence in older patients, though not yet proved, undoubtedly occurs.

Evidence is presented that a partial vitamin C deficiency is of more importance in the healing of surgical wounds in human beings than has hitherto been appreciated. When a low ascorbic acid depot in a patient is found, or suspected, the giving of ascorbic acid, as an aid to wound healing, seems amply justified.

We wish to thank Dr. Sidney Farber for his help in the study and interpretation of the histopathologic data, and Dr. Otto A. Bessey for his help on the chemical and nutritional aspects of the problem.

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BRIEF COMMUNICATIONS AND CASE REPORTS

TUBERCULOSIS OF THE STOMACH *

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NEW YORK

Case Report.—J. R. M., age 49, when first seen complained chiefly of pain in the epigastrium which had grown gradually worse during the preceding five months. It was a burning, stinging, nonradiating pain, relieved by soda but not by food. Two weeks before admission, there had been some nausea and vomiting, but during the past seven days the patient had not been able to retain any food. He had lost ten pounds in five months.

Examination revealed tenderness over the epigastrium with definite muscular resistance. A questionable mass was palpable. The laboratory findings were: red blood cells, 4,800,000, hemoglobin 50 per cent; a gastric test meal showed no free HCl, even after the injection of histamine, and a total acidity varying from 6 to 30 in four expressions; the gastric contents were positive for blood but the feces were negative; the blood chemistry was essentially negative, and the blood Wassermann was negative. A gastro-intestinal roentgenologic examination showed that there was no deformity characteristic of a new growth, or of ulcer of the stomach or the duodenum, but there was a lack of peristalsis of the stomach, and a trace of retention at the end of six hours. The gallbladder visualization was normal. Roentgenograms of the lungs showed no pathology.

An exploratory operation was performed February 21, 1933. The stomach appeared to be thickened on both its anterior and posterior wall, suggesting a lymphatic obstruction. There was no obstruction at the duodenum. The involvement seemed to be general throughout the stomach, suggesting an infiltrating carcinoma (linitis plastica). There were numerous enlarged lymph nodes along both the greater and lesser curvatures. One along the greater curvature was removed for examination and showed tuberculosis (SC 8045). Later, tubercle bacilli were demonstrated in the lymph node. The condition was thought to be inoperable and the wound was closed.

At examination, December 19, 1934, there had been a gain of 45 pounds in weight. Gastric analysis gave findings of free HCl 4, and total acid 12. The patient stated that her appetite and digestion were excellent and that she no longer had eructations of gas.

Roentgenologic examination of the gastro-intestinal tract March 5, 1936, revealed little evidence to indicate pathology of the stomach or duodenum, except lack of peristalsis. Although peristaltic waves were seen to pass along the stomach, these were less than normal. There was, however, no gastric retention at the end of six hours, there being normal motility of the barium meal.

DISCUSSION.—Tuberculosis of the stomach is a rare disease. Broders[1] reports one in 2,500 gastric operations. In the past 20 years, three cases have been presented before this Society. Edwin Beer[2] presented a Negro with tumefaction of the pyloric end of the stomach in 1921. At operation, he said, "on exposing the stomach, at the pyloric end and involving the antrum there was a large tumefaction about the size of an adult palm with

* Presented before the New York Surgical Society, March 25, 1936. Submitted for publication June 6, 1936.

many dozens of enlarged nodes along the lesser curvature and along the greater curvature. The mass in the stomach was freely movable and very firm, and gave the impression of a malignant growth." A subtotal gastrectomy was performed. On examination, the walls of the stomach were found to be thickened to 1.5 cm. The cut surface of the stomach wall was smooth, firm and dead white. There was an enormous tuberculous ulcer with an almost smooth surface which involved the whole antrum, anterior and posterior walls, beginning close to the pylorus and extending well up into the body of the stomach with innumerable nodes in the lesser and greater curvatures.

In March, 1928, Ralph Colp[3] presented a Negro with a solitary tuberculous ulcer of the lesser curvature with a group of caseous tuberculous lymph nodes over the ulcer site. He had entered the hospital with a history of vomiting blood, and tarry stools. Gastric analysis showed free HCl 40, total 60. Roentgenologic examination revealed a penetrating ulcer of the lesser curvature. The lung films showed a healed tuberculous process of the apices of the lungs. A subtotal resection was performed. Postoperative examination demonstrated a punched-out, indurated ulcer on the lesser curvature one and one-half inches from the cardiac orifice and one inch in diameter. In November, 1931, W. Howard Barber[4] presented a Negro who had entered the hospital with a history of pain after meals and vomiting for two years. A large circular ulcer was found near the pylorus, and a stomach resection was performed. Broders' case was taken for a carcinoma of the stomach until after resection. Interestingly enough, this patient had had an exploratory celiotomy elsewhere six months before, and had been closed up because he was thought to have had an inoperable carcinoma of the stomach.

Our patient belonged to the "lymphangitis" type in which the lymph channels were blocked, so that there was a thick, edematous wall throughout. No definite ulcer could be demonstrated by roentgenologic study or by palpation. Although no section of the stomach wall was taken for microscopic study, we believe that it is fair to consider this a case of tuberculosis of the stomach.

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DISCUSSION.—DR. W. HOWARD BARBER (New York) remarked that the present tendency, when diagnosing tuberculosis of the stomach, is to base the diagnosis on a study of morphology and the bacteriologic findings of a given section. But, he added, Doctor Symmers will not make a definite diagnosis on morphology alone, preferring to state "either tuberculosis or syphilis," unless tubercle bacilli are actually found in the section. Doctor Barber explained that the cases referred to by Doctor White as having been reported before the New York Surgical Society by Doctors Colp, Beer and himself had been studied morphologically but were negative bacteriologically, and were, *probably*, tuberculosis. In most instances—80 per cent—the lesions are

ulcers, but occasionally one finds tubercles. The ulcers are found in patients with tuberculosis of the lungs or gastro-intestinal tract and are chronic lesions with excavated margins and polypoid excrescences; or they are ulcers about the pylorus, with thickening, so that they cause stenosis. Broders, in 1927, reported, from the literature, 49 cases which he considered positive, because tubercle bacilli were found in the sections; he also reported 118 cases of probable tuberculosis, that is, on the basis of morphology. Doctor Symmers, however, claims that on his records at Bellevue Hospital there is not a single case of positive tuberculosis of the stomach wall. Bacilli were found in the nodes in Doctor White's case, though no section of the stomach was reported, and, in Doctor Barber's opinion, this case might fall in the group of tubercular lymphadenitis reported by Broders.

ECHINOCOCCUS CYST OF THE LIVER IN A CHILD *

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NEW YORK

Case Report.—A child, age 7, was admitted to the pediatric service of Bellevue Hospital, in charge of Dr. Charles Hendee Smith, December 2, 1935. Filling the upper abdomen was a large mass which caused protrusions above the umbilicus. On palpation the tumor seemed to have a distinct outline and extended from the ensiform cartilage and the costal borders down to two fingers' breadth below the umbilicus. Its surface was smooth and it appeared to spring from the anterior surface of the liver. The abdominal wall was stretched tightly over it, and there were many enlarged superficial veins beneath the skin in this region. The blood count showed 8 per cent of eosinophils. The complement fixation test was positive, as well as a skin sensitization test for echinococcus infection.

Previous History.—She was born in Marseilles, France, of Armenian parents. For the last two years the parents had noticed that she was becoming weaker and more easily fatigued. About 18 months before admission they discovered that she had passed a round worm. They had only noticed the swelling in the abdomen for the last 15 months. A flat roentgenogram showed a distinct rounded shadow in the midline.

Operation.—January 15, 1936, under ether anesthesia, a right paramedial incision was made extending from the costal border down to two inches below the umbilicus; the rectus muscle was retracted laterally. On opening the peritoneal cavity a large cystic mass, measuring about 8 x 15 cm., was discovered in the upper anterior portion of the abdomen. It apparently sprang from the inferior surface of the liver and extended down 8 or 9 cm. below the edge of the liver. The gallbladder was found to be incorporated in the wall of the cyst on the right side and the omentum and a loop of ileum were firmly adherent to it on its left side. The inferior pole of the mass was easily delivered into the wound. The viscera about it were packed back with pads moistened with saline solution. These were covered, in turn, with other gauze pads soaked in 10 per cent formalin solution, and the mass was surrounded on the abdominal surface with gauze saturated with the same solution. The cyst was then punctured with a large aspirating needle attached to a syringe containing 10 cc. of 10 per cent formalin. This was injected into the cavity of the cyst. A small part of the cystic contents was evacuated by the syringe, which was then replaced by the tube of the suction apparatus. Most of the contents were evacuated by this means. In all, the cyst held 500 cc. of a cloudy, ocher colored fluid, of creamy consistency. When the cyst was almost emptied,

* Presented before the New York Surgical Society, April 13, 1936. Submitted for publication June 17, 1936.

its walls were picked up by clamps and an incision made into the cavity. The walls consisted of fibrous tissue and were about three to four Mm. thick. The remaining contents of the cyst were now evacuated with the suction apparatus, which left only a white gelatinous substance which lay in the bottom of the cavity. On investigation this was found to be the entire hydatid membrane which had previously lined the fibrous capsule and was now completely separated from it and lay crumpled up in the bottom of the cavity. This was removed. The edges of the fibrous covering being held up by means of clamps, the entire cavity was filled with a solution of 10 per cent formalin, which was allowed to remain for five minutes before it was sucked out. The walls of the cyst cavity were smooth and free from hemorrhage, and were closed with a double row of chromic sutures, the first interrupted and the second continuous, so that the edges of the wound were folded in.

At no time during the procedure was there any spilling of the contents. The gauze pads were now removed and the wound in the abdominal wall was closed in layers without drainage. The child made an uneventful recovery. Since she left the hospital on February 19, 1936, she has gained weight and become much stronger.

I feel that, where it can be done, the treatment of echinococcus cyst by primary closure, as described by Roberto Alessandri, Professor of Clinical Surgery and Operative Medicine of the Royal University in Rome, is the procedure of choice.

DISCUSSION.—DR. RUSSEL H. PATTERSON (New York) asked Doctor Beekman whether his technic is to open up the large cyst with the multiple small cysts inside like a bunch of grapes, and take out the lining of this cavity, swab it out and close it up tightly. He also asked whether this is usually easily possible.

DR. SEWARD ERDMAN (New York) cited a case upon whom he had operated some seven years ago at New York Hospital, after having read Doctor Alessandri's article on the procedure, which detailed his enormous experience. Doctor Erdman said his experience had been quite similar to that of Doctor Beekman, with the use of formalin. The fibrous coat, as he understood it, properly belongs to the host, and is not part of the parasite. Therefore, that can be left; in fact, it is rather dangerous to attempt to strip it out of the liver bed for the reason that by doing so one is apt to start bleeding or open some small bile ducts. In Doctor Erdman's case, the cyst held 4,000 cc. of clear fluid, the whole being larger than the bladder of a large football, and about 3 Mm. thick, resembling very much the white of a hard-boiled egg, and rather brittle. The attempt was made to obliterate the cavity in the liver by closing it with sutures, bringing the sides of the fibrous walls together, but it was impossible to effect this sufficiently and, moreover, it would have left a large space with considerable oozing. It was, therefore, drained for nearly a month, ultimately closing, and the patient has remained well. The procedure followed by Doctor Beekman, instead of marsupialization, was a good one, closing the abdomen without drainage if possible.

DR. THOMAS H. RUSSELL (New York) said that he had had a similar case of echinococcus cyst recently, in the left lobe of the liver, which he understood to be unusual. The diagnosis was made preoperatively, due to crepitation which one could elicit. He said that he did not know exactly what to do with the cyst as he had not seen any cases operated upon before. However, after resecting the lower part of it, which was adjacent to the transverse mesocolon, and seeing that part of the wall was imbedded in it, he had to resect a large piece of the transverse colon. Then, when he tried

to remove the membrane from the liver, there was so much bleeding that he left it in, choosing to use instead an old-fashioned cautery with which he cauterized the inside of the cyst, left the cyst in, drained it, and then performed a Mickulicz procedure on the colon. Later, to his surprise, during a dressing there appeared to be a great big piece of gauze hanging out. He took hold of this and the entire wall of the cyst came out, after which, when he completed the Mickulicz procedure, he did not find any evidence of the cyst.

Dr. Fenwick Beekman (New York), in conclusion, explained that the fibrous capsule has nothing to do with the parasite, but instead is formed by the body, due to irritation caused by the parasite, and so it is not necessary to do anything about removing it. The hydatic membrane in the patient presented looked very much like the white of a hard-boiled egg, and when removed appeared to be complete. There was only a single cyst in this case. The cases with cysts like bunches of grapes are very late. The material removed from the cyst in the present instance was full of hooklets. Alessandri makes a point of primary closure and warns very strongly not to obliterate the cavity, because if this is attempted, one is going to open blood vessels and bile ducts so that there will be trouble later on. He believes that the cyst cavity should be washed out with 10 per cent formalin, and this was done in the case shown. The only contraindication to primary closure is where the cyst is infected, in which event marsupialization becomes necessary. Doctor Beekman said he had not seen a case similar to that described by Doctor Russell.

ACUTE PERFORATION OF A CANCEROUS GASTRIC ULCER

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Carcinoma of the stomach has a high mortality but death is rarely caused by generalized peritonitis resulting from acute perforation. Peritonitis more rarely causes death without perforation, though a few such cases have been reported. Acute perforation usually occurs with a patient at rest in bed while under observation or medical treatment for gastric carcinoma, but it is exceedingly rare for acute perforation to occur when one is actually engaged in his usual occupation. One such case has been reported by Aird.[1] The one herein reported is similar.

Case Report.—E. W., male, age 51, iron worker, was admitted to the Roxborough Memorial Hospital, with a diagnosis of acute perforation of a peptic ulcer. His mother had died at 60 from "cancer of the liver." Family history otherwise was irrelevant. For 15 months this patient had been troubled with gastric symptoms. A sensation of burning was the first symptom. This was usually relieved by taking food but was followed two hours after meals by hunger pains. There was never any nausea, vomiting, or aversion to food, nor did any particular kind of food aggravate the symptoms. Constipation was chronic but moderate. He had on one occasion been given medicine without relief of symptoms but no systematic regimen had ever been prescribed.

Immediately before perforation he had lost about five pounds in weight and his

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gastric symptoms were more intense but had not interfered with his occupation. On the day of perforation he had gone to work feeling well. He worked for four hours and while stooping was taken with sudden, severe, upper abdominal pain so that he was unable to straighten up. When brought to the hospital, physical examination revealed all the classical signs of an acute perforated peptic ulcer. Rectal examination revealed some fullness and tenderness in the cul-de-sac. Temperature 96.4°F. Pulse 84. Respiration 24. Blood pressure, 126 80. Blood count: Hb. 90 per cent, R.B.C. 4,750,000, W.B.C. 10,300. Urine normal. Lungs were clear and heart normal. Immediate operation was decided on.

Under gas ether anesthesia, the abdomen was opened through a right rectus incision. A perforation was found on the lesser curvature of the stomach about two inches from the pylorus. It was approximately one-quarter inch in diameter. On the serosa at the margin of the perforation was a hard, irregular, fixed nodule about one-half inch in diameter. The crater of a gastric ulcer, approximately two inches in diameter, was palpated. It was very hard. One enlarged lymph node in the lesser omentum was found and removed, and also a small section of tissue from the nodule at the margin of the perforation. It was decided that we were dealing with acute perforation of a chronic gastric ulcer which had undergone malignant degeneration. The edge of the perforation and ulcer floor was treated with the actual cautery and the opening closed by through and through suture and inversion with the stomach wall. A suprapubic drain was inserted. The patient reacted promptly and made an uneventful recovery. Dr. Howard Schaffer examined the specimens removed histologically. He reported that the tissue from the nodule was hyalinized and contained many fibroblasts, some polynuclear and some irregular and pyknotic carcinomatous cells scattered throughout. The lymph node was reported as metastatic adenocarcinoma.

Gastric analysis ten days after operation showed: Free acid: 17-66, total acid, 51-120 in terms of N/10 NaOH in 100 cc. of gastric contents. The blood sugar was 100 mg., urea 17 mg., and the blood Wassermann was negative. Blood count at this time was: Hb. 75 per cent, R.B.C. 3,680,000, W.B.C. 7,800. Urine normal.

Eighteen days after the acute perforation a partial gastrectomy was performed, after Moynihan's technic, through an upper left rectus incision. The pylorus and all palpable regional lymph nodes were removed. This operation included an anterior end-to-side gastrojejunostomy. The following day a direct transfusion of 400 cc. of blood was given. The patient made an uneventful recovery and left the hospital on the twenty-first postoperative day. During the following 33 days he gained 15½ pounds in weight. Gastric analysis repeated at this time revealed: Free acid: 0, total acid: 8-25.

Pathologic Examination by Dr. Baxter L. Crawford, showed an ulcerated area in the stomach, the floor of which was composed of fibrous tissue in which there was a marked inflammatory reaction. At the edge of the ulcer and in the floor, there was extensive infiltration by masses of epithelial cells. The infiltrating epithelial cells were of the columnar type, large and vacuolated, with a large amount of mucoid secretion throughout the tissue. The infiltrating epithelial cells involved all the coats of the stomach, but at the margin seemed fairly sharply defined. Beyond the area infiltrated by the epithelial cells there was an extensive inflammatory reaction, with fibrosis and mononuclear cell infiltration involving the submucous and muscular coats. This fibrosis caused a fusion between the submucosa and the muscular coats. The inflammatory reaction involved a much larger area than was involved by the carcinoma. The enlarged lymph nodes also contained small collections of infiltrating epithelial cells in which there was much mucoid secretion. *Diagnosis:* Adenocarcinoma, (mucoid) perforating, of the stomach, with metastases to the regional lymph nodes.

COMMENT.—In 1896, Frederick A. Packard[8] reported a case of acute perforation of a gastric carcinoma in a patient who had had symptoms over a period of two years. In 1910, Anders and McFarland[2] reported a similar

case. No operation was performed in either but the diagnoses were confirmed by autopsy.

In 1904, Sir Cooper Perry and Lauriston E. Shaw[9] recorded 20 perforations found at autopsy in 306 fatal cases of gastric cancer. In this report six instances of acute perforation are recognized. Death occurred from generalized peritonitis in five. A localized abscess was found in the other. No surgical intervention had been attempted. They found 17 cases without perforation who had died from generalized peritonitis.

Ian Aird,[1] in 1934, reported a case of acute perforation of a gastric ulcer that came to operation six hours after its occurrence. Closure was effected and recovery resulted. Enlarged nodes found at operation revealed adenocarcinoma on histologic examination. Because of these metastases no further operative procedure was attempted. He collected reports of six other cases which had undergone operation. Simple closure was effected in five, and closure with gastro-enterostomy in the other.

From a thorough investigation of the literature on this subject, Aird attempts to distinguish between primary carcinoma and ulcer with cancerous degeneration. He found that only 67 of the 79 reported cases were accompanied by clinical histories, which made classification possible. In 44 the perforations were acute and classified as fulminant. Twenty-four of these 44 cases underwent operation and 11 left the hospital alive. This is an operative mortality rate of 54 per cent. The diagnosis of malignancy was confirmed in approximately one-half of these cases. In the 24 cases operated upon, seven were treated by immediate gastrectomy. All of these survived operation. Aird concluded, from his study, that five of the 44 fulminant cases were definitely ulcer-cancer and six were definitely primary cancer which had ulcerated.

Delaginere,[3] in 1923, reported a case of acute perforation treated by closure and followed later by gastrectomy. His patient was well ten years afterwards. This, with the seven cases of successful immediate gastrectomy following acute perforation, is the only *other* successful one reported in the literature.

Determination of simple gastric ulcer previous to carcinomatous degeneration is attended with considerable difficulty. Findings that point toward such a condition are historic, clinical and pathologic. Important points in the history are duration and character of symptoms and weight loss. Clinical findings include those from operation and laboratory determinations of gastric contents. Of the pathologic findings, histologic examination is the determining one. Various criteria have been offered by pathologists in their attempts to determine the relationship between gastric ulcer and gastric carcinoma. Those given by Wilfred Newcomb[7] are valuable. He states, after exhaustive research, that there are four points in which a simple ulcer usually differs from carcinoma of the stomach: (1) Complete destruction of an area of muscle corresponding in size roughly to the floor of the ulcer. (2) The

presence of a large area of dense fibrous and granulation tissue in the floor of the lesion. (3) The presence of endarteritis or thrombophlebitis in the surrounding vessels. (4) Fusion or close approximation of the muscularis mucosa and muscularis at the margin of the ulcer. The last named, he believes, is the only definite evidence of preexisting peptic ulcer not given occasionally by primary carcinoma. Doctor Crawford believes that extensive inflammatory reaction and fibrosis in the submucous and muscular layers of the stomach wall beyond the area involved by the cancer seem to indicate a preexisting inflammatory reaction such as occurs in simple ulceration.

The case presented herein gave a history of gastric symptoms for a period of 15 months before perforation. His total weight loss was five pounds. This loss occurred in a very brief period of time immediately preceding perforation. The gastric analysis revealed definite hyperchlorhydria. There was no anemia. The perforation was of the fulminant variety in contradistinction to "silent" perforations usual in those from primary cancer. Histologic examination gave evidence of definite fusion of the muscularis mucosa and the muscular layer of the stomach at the ulcer margin; also extensive inflammatory reaction and fibrosis in the submucous and muscular layers of the stomach wall beyond the area involved by the cancer. From these findings a diagnosis has been made of peptic ulcer with secondary carcinomatous degeneration.

Treatment is best considered as two distinct procedures: The treatment of the perforation and treatment of the carcinoma. The lowest mortality rate results from simple closure of the perforation in peptic ulcers. There seems little reason for further immediate operative procedure even in the presence of malignant change. If the stomach is resectable and if metastases have not involved the liver and the portal structures, secondary operation is definitely indicated. Complete removal of the involved tissue with the pylorus and regional nodes and those in the lesser omentum and about the pancreas is indicated.

Moynihan[6] states that if cancer develops in connection with a chronic gastric ulcer, recurrence is rare. Finsterer[4] found that the prognosis of cancer in the presence of free hydrochloric acid is about one-half as good for five year survival as in cases of anacidity. Hartman's[10] figures from the Mayo Clinic correspond with Finsterer's.

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PILONIDAL SINUS IN A NEGRO *

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PHILADELPHIA, PA.

FROM DR. P. A. MC CARTHY'S SURGICAL SERVICE, PHILADELPHIA GENERAL HOSPITAL

WE ARE recording this case because pilonidal sinus and cysts are rarely found in the colored race. We believe it is an uncommon occurrence except among the Caucasian. This point is emphasized by most authors in the report of several hundreds of cases. Dr. H. B. Stone of Baltimore, in 1924, was among the first to call our attention to the fact that there were no Negroes in his series of 61 cases. Dr. G. W. Horsley of Richmond, in 1933, made the same observation and in 1934 Dr. Hubley B. Owen stressed this point in reporting a series of 40 cases. Questioning several other active surgeons, we found that none had seen a pilonidal sinus in a Negro. In reviewing the literature, we found one case was reported by Hansler and Anderson in 1934. Breidenbach and Wilson reported four cases, in a series of 288, from Bellevue Hospital.

Case Report.—A boy, J. W., colored, single, age 18, was admitted July 5, 1935, to the Philadelphia General Hospital, complaining of a burning "discharge from rectum." His antecedent history was quite irrelevant.

Present Illness.—First noticed blood stains about three months ago, with constant moisture at the base of his spine. About one month ago a lump formed. He was examined proctoscopically and admitted to the hospital with a diagnosis of pilonidal cyst.

Physical Examination.—There was a small draining sinus in the midline about one and one-half inches above the anal orifice. There was no tenderness, although the edges of the sinus were somewhat raw and bled easily. He had a good anal sphincter, and no mass or tenderness was noted inside the rectum.

Operation.—Under general anesthesia methylene blue was injected into the sinus and the anal sphincter dilated. No dye was noted inside the rectum. The sinus which extended toward the coccyx was then excised. The structure of the tissue and the direction of the tracts were those commonly found in instances of pilonidal sinus. The wound was packed with iodoform gauze without sutures. The patient was discharged July 17.

Pathologic Examination.—The specimen consisted of a mass covered with pigmented skin which presented a dimple leading into a blue stained sinus tract. On section the tract led into a space filled with granular débris, the subcutaneous fascia was firm and fibrosed. Microscopic section (R. P. Custer) showed a surface covered with negroid skin and appendages. The sinus tract led to a cystic space which was largely filled with chronic granulation tissue, and which contained hair in degenerated state. No actual hair follicles remained. The surrounding tissue was densely fibrotic and chronically inflamed. Diagnosis.—Pilonidal cyst (Fig. 1).

COMMENT.—There is dispute as to the origin of pilonidal cysts and sinuses. Some authors think they are neurogenic and others ectodermic. The opinions seem to be equally divided, although the theory advanced by Harvey Stone that they are analogous to the preen glands in birds and amniotes, which develop at puberty, is gaining more adherents. Regardless what theory

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one accepts, we cannot escape asking ourselves this question: Why do not pilonidal cysts occur in the pure colored race? We say pure because we have no assurance that there was not white man's blood flowing in the veins of the five reported cases. Fansler and Anderson, judging by the color of their patient, believed she was one-eighth Caucasian.

FIG. 1.—Photomicrograph showing sinus tract with hair follicles and granular tissue.

The only reasonable answers we think of is the negroid pigmentation. It either inhibits the activities of the lining cells of the sinus, or neutralizes their products by chemical action. This point is worthy of further consideration, and may lead us into virgin fields of investigation. This condition should also be of great interest to the anthropologists, because it may lead to newer knowledge in the development of the human race.

MEMOIRS

REA SMITH

1876–1935

CALIFORNIA and the Pacific Coast have lost a distinguished surgeon in the passing of Dr. Rea Smith, on November 29, 1935; his death was sudden,

REA SMITH, M.D.

unexpected, and it brings to a dramatic close the successful career of one of our most important surgeons, esteemed citizens, and beloved friends.

He was born in DeKalb, Ill., on November 16, 1876, to Addie A. Smith and Dr. Everett Russell Smith. His father, one of California's earlier and outstanding surgeons, was a man of learning and distinction, whose intellectuality seemed to find full expression in his son. Rea attended the Los Angeles High School and was graduated with honors in 1895; he entered Stanford University where he received his B.A. degree in 1899; in 1902 he received his degree of Medicine from the University of Pennsylvania. While attending Stanford University he received his "S," being a member of the Varsity football team. His fraternities were the Zeta Psi and Phi Alpha.

Early in his career he took an active interest in organized medicine and community problems, giving generously of time, energy and money. His mind was alert and inquisitive, his vision clear; his untiring energy and unusual ability qualified him for the high position he attained. In his greatness he was quiet, retiring, and free from petty jealousy, but if occasion demanded his leadership, he was direct and incisive, and accomplished that which was his goal.

Then came the call to the World War and he organized Base Hospital No. 3, with service on shore and with a Grand Fleet. Loaned to the Army with Evacuation Hospital No. 114, he shirked duty at no time, as was well demonstrated during the Argonne drive where, as always, he did more than his full share; he retired as Captain U. S. N., R.F.

For 32 years he was engaged in the practice of medicine. He possessed in full measure the qualities of a fine surgeon, and, having a definite inclination along this line, he devoted himself to this specialty. His judgment was good and his ability such that he rapidly rose to fame, being appointed from time to time to positions of honor. He served as Clinical Professor of Surgery in the University of Southern California; Past President of the Pacific Coast Surgical Society; Past President of the Los Angeles Medical Society; member of the American Surgical Association and of the American College of Surgeons, as well as belonging to state and local societies.

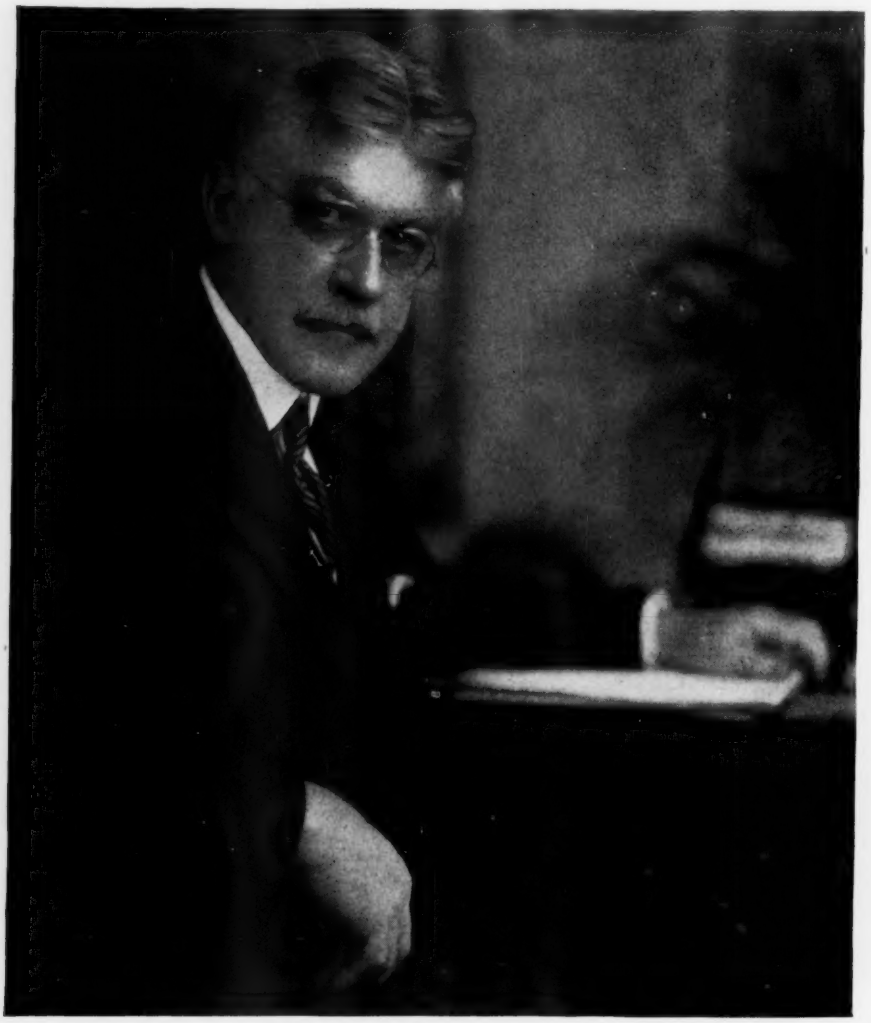
The esteem and affection by which he was regarded in the medical associations give only a slight idea of how highly he was thought of in general. His loss to our profession is felt profoundly; it is a deep sorrow to his multitude of friends. Genial, understanding, full of humor and human kindness, a noble, generous soul, exalted by boundless sympathy for his fellow men, he possessed an unswerving sentiment for principles of honor and right; he was devoted to his patients, associates, friends and family, who, in turn, loved him to a degree approaching adoration. Such was the personality of Dr. Rea Smith. Long will his memory live. He is survived by a wife and two sons, Everett R. Smith and Dr. Gordon K. Smith.

EDWARD C. MOORE.

CHARLES HARRISON FRAZIER

1870–1936

Dr. Charles Harrison Frazier was born in Philadelphia, April 19, 1870; educated in the Episcopal Academy and the University of Pennsyl-



Charles Harrison Frazier, M.D.

vania, Class of 1889. He graduated from the Medical School of that university in 1892. Hospital internships under Dr. J. William White and Dr.

John Ashurst at the University and Episcopal Hospitals completed his preliminary medical training. A year or more in Europe of postgraduate work in surgery, pathology and neurology under von Bergmann and Virchow rounded out his studies. On his return to Philadelphia in 1896 he was appointed to the clinical and teaching staff of the Medical School of the University of Pennsylvania.

It was an important period in the development of medical education in this country. The leaders of the profession had for some time realized that the standards of medical education in this country were inadequate and that the methods of instruction needed definite revision. Fresh from his European experience Doctor Frazier was heartily in accord with these changes. In 1901 he was appointed Dean of the University of Pennsylvania School of Medicine and Professor of Clinical Surgery. For the next ten years he labored to put the Medical School in the front rank of similar institutions in this country. It was a hard, thankless task, a battle against inertia, against the opposition of those long connected with the school who resented the suggestion that their ideas and methods were becoming outmoded. While many of his plans failed of immediate realization, he had the satisfaction later of seeing most of the more important fully fulfilled and the school directed along the pathways which his leadership and vision had indicated.

While Dean of the Medical School he had time to carry on an increasingly heavy surgical practice, to establish and edit the University of Pennsylvania Medical Magazine, to establish one of the first laboratories of surgical pathology organized in this country, to lay the foundations for a department of research surgery, and, with Spiller, to carry on the experimental work on the treatment of trigeminal neuralgia which later made the surgical relief of this condition a safe procedure.

In 1898, Doctor Frazier was elected a member of the Philadelphia Academy of Surgery. His first presentation before it was made in 1902, when he described a retractor to elevate the brain. In 1908, he gave the Annual Oration. In 1912, he was elected vice president, and in 1916, president. His two chief surgical interests were the surgery of the central nervous system and of goiter. While most of the papers presented before this Academy concerned the thyroid, two important communications, one on the transfrontal approach to the hypophysis, and the second on suture of the recurrent laryngeal nerve, touched on his original and ingenious development of neurosurgical technic.

During the War, he was neurosurgical consultant to the Surgeon General. He had charge of the Neurosurgical Service at Base Hospital No. 11, at Cape May and No. 41, at Fox Hills, Staten Island. He represented the Surgeon General at the Interallied Surgical Conference in Paris, in 1920, presenting a paper on the "Results of the Treatment of Injuries to the Peripheral Nerves."

In 1922, Doctor Frazier was appointed John Rhea Barton Professor of Surgery in the University of Pennsylvania Medical School. His ability as

an organizer was at once apparent. The Surgical Service was adapted to the needs of the student and steps taken to use the teaching material to the best possible advantage. A proper relationship was established between the clinical and research departments and every effort made to demonstrate not only the routine surgical procedures but to stress the physiologic, pathologic and physiochemical facts upon which such maneuvers are based.

Many honors came to Doctor Frazier. He was a Fellow of the College of Surgeons; a founder and president (1925–1927) of the Society of Clinical Surgeons; a founder and president (1922–1923) of the Society of Neurologic Surgeons; president of the American Neurologic Association (1928–1929); a member of the American Surgical Society; of the American Society for the Study of Goiter; an honorary member of the Deutsche Akadamie der Naturforcher; and of the British Neurosurgical Society. He received the degree of Doctor of Science from the University in 1925 and was elected one of its Trustees in 1934.

Anyone who knew Doctor Frazier was bound to him by affectionate respect and esteem, and even though his frankness of speech might sometimes hurt, one could not long resist his charm. What he demanded above everything else of all people was honesty, honesty of mind and the willingness to work with honest purpose. Where he found these qualities he gave himself without reserve and his support was whole hearted.

He died at North Haven, Maine, July 26, 1936. During the last ten months of his life he suffered pain continuously and knew the nature of his illness. In spite of this he continued an active interest in the affairs of the Surgical Department, making suggestions and plans for the future, uncomplaining and patient under his affliction. His last months were an epitome of his life. Under opposition and against odds, he fought gallantly never losing his self-control and refusing to admit defeat.

FRANCIS C. GRANT

EDITORIAL ADDRESS

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